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Using Interactive Video for the Acquisition of Sign Language Skills

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USING INTERACTIVE VIDEO FOR THE ACQUISITION OF SIGN
LANGUAGE SKILLS

by

Mary Anne Skummer

A Dissertation Submitted to the Faculty of the Graduate
School of Education of Loyola University-Chicago in
Partial Fulfillment of the Requirements for the Degree
of Doctor of Education

January

1990

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Loyola University-Chicago

USING INTERACTIVE VIDEO FOR THE ACQUISITION OF SIGN
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The purpose of this investigation is to examine information processing capabilities when, with sign language as the content, interactive CAI is the protocol.

The analysis of the data and conclusions drawn from this study should aid instructors in determining whether or not a particular individual can benefit from interactive CAI. Measuring the level of perceptual-motor efficiency could determine whether or not a particular learner can acquire mastery in the content area of sign language when interactive CAI is the protocol.

Another issue considered in this investigation is whether or not interactive CAI is a useful tool for sign language learning. Interactive CAI might possibly stand alone or, at least serve as a supplement to a sign language course.

The review of the literature reveals that the majority of the publications have been descriptive rather than statistical in nature. Thus, there is no

evidence to conclude that interactive CAI would facilitate learning when sign language is the content. As a result of the above observations, the major intent of this study was to provide valid, empirical data that would assist practioners in the field to make important decisions concerning the implementation of interactive CAI in the acquisition of signing skills.

Adult learners served as subjects in this experiment. These individuals were characterized as those with a manifest interest for sign language and 'others'. The issue considered here is whether or not a difference exists on the receptive identification and expressive signing scores of those subjects having a mainifest interest and not having a manifest interest for learning sign language.

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Finally, a very special thank you to my Mom for her support and patience throughout this endeavor. I would only wish that my Dad could have been here to share this joy.

VITA

The author, Mary Anne Skummer, is the daughter of Joseph Skummer and Marie (Babiarz) Skummer. She was born on January 11, 1951.

Her elementary and secondary education was obtained in the Archdiocese of Chicago, Catholic school system.

In September, 1969, Ms. Skummer entered Loyola University, Lake Shore Campus, Chicago, Illinois. In May, 1973, she received the degree of Bachelor of Science with a major in Biology. In September, 1973, she enrolled at Northwestern University, Evanston, Illinois, and in August, 1975, was awarded the Master of Arts degree, with a major in Communicative Disorders-Education of the Hearing Impaired. In September, 1977, Ms. Skummer's educational pursuit continued at Roosevelt University, Chicago, Illinois, and, in May 1982, she attained the Master of Arts degree, with a major in Special Education-Educable Mentally Handicapped. Enrollment at Roosevelt University was extended until December, 1982, at which time course requirements for the

Administration/Supervision endorsement on her State of Illinois special education certificates were completed.

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CHAPTER I
INTRODUCTION

Background and Nature of the Study

Consistent with current understandings, language development, for the hearing impaired, occurs through the use of sign language (or manual communication as it is sometimes labelled). By 1985, it was estimated that there were 19.2/1000 individuals, in the United States, under the age of 18, exhibiting some degree of hearing impairment. (Approximately 21,198,000 people, nationwide, are hearing impaired (Statistical Abstracts of the United States, 1988 edition)). The need for educators of the hearing impaired having minimal sign language training rose as 'mainstreaming' became the trend. Jordan, Gustason, and Rosen, 1979, conducted a survey which indicated that 37% of the hearing impaired were mainstreamed into regular classes (Evans, 1982). The stigma that had been attached to signing, in recent years, has been removed and the presence of an interpreter at meetings, speeches, etc., is expected. Public Law 94-142 indicates that in the event that the child and/or his/her parents are hearing impaired, an interpreter must be provided at all staffings, hearings

or other selected meetings.

Individuals servicing other handicapping conditions, e.g., the mentally retarded, are including sign language as a means of teaching receptive/expressive language skills. (Smith) states that studies have suggested that the mentally retarded are sometimes unable to process stimuli through the auditory channel because of "auditory discrimination problems, memory disturbances, and environmentally induced inhibiting factors" (p. 186). He goes on to say that "nonorganically involved retarded children are stronger in visual than in auditory reception and interpretation of stimuli" (p. 186). Because it is visual in nature, sign language is encouraged for the mentally retarded and others possessing disabilities rendering them non-verbal. The table below lists numbers of children with handicaps other than hearing impairment:

TABLE 1

ENROLLMENT IN SPECIAL EDUCATION PROGRAMS IN PUBLIC
ELEMENTARY AND SECONDARY SCHOOLS: UNITED STATES, FALL
1980

Type of Handicap	Enrollment	% in Full-time Programs
Educable mentally retarded	563,364	42.3
Trainable mentally retarded	94,718	90.0
Hard of hearing	28,740	20.9
Deaf	17,850	55.2
Speech impaired	908,241	1.9
Visually handicapped	17,330	19.7
Emotionally disturbed	182,931	43.5
Orthopedically impaired	39,119	51.7
Other health impaired	66,381	35.0
Learning disability	1,262,535	11.8
Deaf-blind	960	65.3
Multihandicapped	52,168	72.2

(Digest of Education Statistics, 1983-84)

Statistics for the state of Illinois are as follows:

TABLE 2

COMBINED P.L. 94-142 AND P.L. 89-313 CHILD COUNT
 FIGURES BY PRIMARY CATEGORIES AND AGES FOR SCHOOL YEAR
 1986-87

<u>Handicapping Condition</u>	<u>Total</u>
Educable mentally handicapped	19,449
Trainable mentally handicapped	7,625
Hard of hearing	1,627
Deaf	1,483
Speech and language impaired	72,057
Visually impaired	1,088
Behavior disordered	23,002
Physically handicapped/crippled	4,199
Other health impairment	1,704
Learning disabled	101,383
Deaf-blind	48
Educationally handicapped	4,973
Severe/Profound Mentally Handicapped	2,455

(Illinois State Board of Education Report, December 1988)

In addition to educators and interpreters, parents of the hearing impaired need to acquire signing skills as quickly as possible so as to communicate with their child in the home. (Bornstein) emphasized that "a sign system must be learned by members of the family during the very time it is used with a child in the home" (p. 156). The need for training in this content area is becoming more and more evident. It is still true today that the number of qualified instructors is not sufficient to meet this need.

There are a variety of (sign language) videotapes marketed, today. Sign language videotapes were developed to meet the deficit created by the lack of sufficient numbers of instructors needed for training parents, teachers, support staff, etc., working with the hearing impaired and as supplements to sign language classes. What both the tapes and classroom presentations often fail to determine is whether or not the learner has acquired mastery of sign language. EBSCO Curriculum Materials has developed a graphics drill/tutorial (computer) program for fingerspelling. Both the graphics and videotapes fail, however, to pace a lesson or allow for review (of a specific section). (Computer) authoring systems, designed to develop instructional lessons, enable the 'programmer' to add 'loops' that force the learner to review material s/he has not yet mastered and/or 'branches' that take that learner into more difficult themes that are built upon previously acquired knowledge. Graphics cannot display movement through three dimensions nor sequence (initial and final positions of a sign). In addition, (sign) orientation or, spatial relationship of the hands to each other, is not always clear.

The better solution would be the electronic linkage of videotapes/videodiscs with (computer) programs or 'interactive video'. The (program) 'menu' provides the learner with the opportunity to either review earlier material or proceed to the next level. The keyboard, in interactive video, functions as a 'remote control' enabling the learner to 'rewind' a particular scene or 'fast-forward' the tape; in other words, pace the lesson. S/he has the option to run through a practice drill or, perhaps, complete the quiz. Most authoring systems have the capacity to record response times and scores. These figures can serve as determinants for the learner's advancement.

The 'kind' of sign language included in the interactive CAI for this study is labelled "Signed English". Three types of sign language can be discussed here. One is Ameslan (American Sign Language or ASL), another is Signed English and, finally, Signing Exact English (SEE). Ameslan is used, mainly, by deaf adults. It is a language in its own right and not a visual representation of English. Studies have indicated that children of deaf parents, learning Ameslan as their native language, mastered English to a

greater degree than children not exposed to sign language (Brasel and Quigley, 1975). (Gustason) devised SEE in an effort to alleviate the "difficulty hearing parents may have mastering a second language (Ameslan)" (p. X). She goes on to say, in the preface, that "it may be simpler for most hearing parents to begin with a form of signing in English" (p. X). SEE utilizes no less than seventy-four markers denoting past tense, plurals, adverbs, adjectives, etc. Initialization is employed, allowing for separate English equivalents. For example, the base (Ameslan) sign for "room" is altered in that, while the movement is the same, the hand-shapes are now "a" and "p" to represent "apartment" or "o" to represent "office". (See Appendix A-I.) The emphasis behind SEE is to encourage the hearing impaired youngster to use grammatically/syntactically correct English. Ameslan has not been rejected, in this instance, but rather 'improved' upon.

On the other hand, however, (Bornstein) argues that "by attempting to represent sound and spelling as well as meaning, the SEE systems include rules which lead to the creation of a number of synthetic signs

that not only differ in character from those found in Ameslan but often take longer to execute or form" (p. 425). Bornstein involves initialization and fourteen sign markers in Signed English. He encourages fingerspelling to fill in for any additional structural features of English. Avoidance of these "synthetic" signs allow for the Signed English user to communicate with a deaf adult with minimal difficulty.

Total Communication (TC), the simultaneous use of speech and sign, has been promoted within the last two decades. TC provides the hearing impaired individual with oral, aural and visual stimuli. (Pahz and Pahz) state that "the right to learn to use all forms of communication available to develop language competence" is the philosophy behind TC (p. 100). The mode of manual communication (sign) that best follows English word order would be either Signed English or SEE. From the above discussion, one concludes that signing has undergone significant change, in recent times, to facilitate language development.

A video presentation has an advantage over illustrations or (computer) graphics in that, while all three are two-dimensional, the video has the capacity

to display movement, one of the characteristics of sign language. Perception is the interpretation of sensory stimuli. Specifically, (Moran and Kalakian) define perceptual-motor efficiency as "the ability to interpret sensory stimuli as they relate to or result from motor experiences. Perceptual-motor efficiency may involve perceiving through the medium of movement or making appropriate motor responses following the interpretation of sensory input" (p. 269). Visual spatial awareness and laterality/directionality, two components of perceptual-motor efficiency, are necessary for interpreting hand movements for sign reception and reproduction. Visual spatial awareness is one's ability to "conceptualize distances between and among objects in space" (p. 280). Laterality is "an internal awareness that the body has a left and right side" (p. 287). An individual's capacity to "conceptualize left-right, above-below, front-behind, and various combinations of such directions" is directionality (p. 287).

The question of whether or not interactive CAI compensates for weaknesses in perceptual-motor efficiency will be investigated. On the other hand,

the possibility that this protocol provides too much information, i.e., the visual presentation is confusing, must also be considered.

Purpose of the Study

The purpose of this investigation is to examine information processing capabilities when, with sign language as the content, interactive CAI is the protocol. The major research questions to be addressed are as follows:

- 1a. Is the subject's score on the Embedded Figures Test (a measure of perceptual functioning skill), a good predictor of success with (interactive) CAI?
- 1b. Is the subject's score on the Embedded Figures Test (a measure of perceptual functioning skill), a good predictor of success with video presentations?
- 2a. Is the score on the Revised Minnesota Paper Form Board Test (a measure of spatial aptitude), a good predictor of success with (interactive) CAI?
- 2a. Is the score on the Revised Minnesota Paper Form Board Test (a measure of spatial aptitude), a good predictor of success with video presentations?
- 3a. What difference is there on the receptive identification quiz scores among those subjects exposed to (interactive) CAI (Treatment 1), those viewing a (sign language) tape (Treatment

- 2), and those participating in a sign class (Control Group)?
- 3b. What difference is there on the expressive signing scores among those subjects in Treatment 1, Treatment 2 and the Control Group?
- 4a. What difference is there on the receptive identification quiz scores between those subjects having a manifest interest and those not having the manifest interest for learning sign language?
- 4b. What difference is there on the expressive signing scores between those subjects having a manifest interest and those not having the manifest interest for learning sign language?

The Revised Minnesota Paper Form Board Test and the Embedded Figures Test determine the level of one's ability to reproduce a three dimensional image after observing it on a two-dimensional plane. Thus, both treatment groups 1 and 2 will be assessed.

McGraw-Hill Interactive Authoring System has the capacity to record response times and scores. Treatment groups 1 and 2 will complete the 'computerized' quiz which will provide this data. The two variables, response time and score, specify 'mastery rate'.

The parameters for the subjects will be as follows: those with the manifest interest for learning sign and 'others'. These two groupings will be taken

into consideration when analyzing the above-mentioned scores. In addition, demographic data was collected related to: 1) sex and 2) age.

Importance of the Study

The analysis of the data and conclusions drawn from this study should aid instructors in determining whether or not a particular individual can benefit from interactive CAI. The level of perceptual-motor efficiency could determine whether or not a particular learner can acquire mastery in the content area of sign language when interactive CAI is the protocol.

Another issue that will be considered in this investigation is whether or not (interactive) CAI is a useful tool for sign language learning. Interactive CAI might possibly stand alone or, at least, serve as a supplement to a sign language course. A pilot study was conducted and modifications were made, based on the reactions to the protocol, of the individuals involved.

Delimitations of the Study

The following limitations are noted:

1. The computer software/hardware needed for interactive video is unique and may not be readily available. Thus, replicating this

experiment will be difficult unless a specific VTR (video-tape recorder) is used. The interactive CAI developed for this investigation requires the McGraw-Hill Delivery Diskette for booting (starting up) the program.

2. This particular interactive CAI presents signs in isolation only. This study is concentrating on the issue of information processing only and not the transfer of learning from single signs to sentence building.
3. Signs in the topical area of 'food' were selected for use in this investigation. More abstract concepts such as verbs were not considered. The emphasis, here, was on acquiring a very basic sign vocabulary.
4. This investigation is not designed to evaluate retention of what has been learned over time. A possible follow-up study might examine the effects of interactive CAI on long-term memory for this particular content area.

The Research Problems and Hypotheses

This research study analyzed data from adult learners who utilized (interactive) CAI or media as the methodology for acquiring sign vocabulary. The 'control group' participated in a traditional, classroom lesson. The subjects' 'information processing' skills (perceptual functioning and spatial aptitude) were assessed. The results were analyzed in order to determine if these skill levels were good predictors for mastery rate.

The following hypotheses were tested in the investigation:

1. There is no significant correlation between an individual's score on the Embedded Figures Test and interactive CAI mastery rate when sign language is the content.
2. There is no significant correlation between an individual's score on the Embedded Figures Test and video presentation mastery rate when sign language is the content.
3. There is no significant correlation between an individual's score on the Revised Minnesota Paper Form Board Test and interactive CAI mastery rate when sign language is the content.
4. There is no significant correlation between an individual's score on the Revised Minnesota Paper Form Board Test and video presentation mastery rate when sign language is the content.
5. There are no significant differences in performance among subject/treatment groups on the receptive identification quiz scores.
6. There are no significant differences in performance among subject/treatment groups on the expressive signing scores.

CHAPTER II
REVIEW OF THE LITERATURE

An Overview

The purpose of this chapter is to review the literature and research regarding 1) CAI with sign language as the content and 2) the information processing capabilities that may affect (CAI) mastery. The first section includes a brief discussion of educational systems for the deaf and an overview of the current status of research in sign language training utilizing CAI as the methodology. The subsections related to part two review a) research relating to principles of instructional design, b) guidelines and c) evaluation techniques specifically for CAI. The third describes the research regarding information processing capacities. This final section will focus on perceptual skills (visual) necessary for acquiring a sign language vocabulary.

There is little argument that CAI has many advantages with two most commonly understood as being pacing and individualized instruction. But, unfortunately until recently, little consideration is given to the 'type' of learner that would best benefit from CAI. It should be noted that earlier studies

regarding CAI and Sign Language have only been descriptive in nature with no statistical analysis whatsoever.

History of Systems of Educating the Deaf

In 1817, the first school for the deaf opened in Hartford, Connecticut. Thomas Gallaudet, the school's founder, established the manual method of communication which he had studied while in Paris. Originally, this communication system did not follow normal discourse but, later, a more 'natural' American sign language evolved.

Horace Mann, after observing the oral methods used in schools for the deaf in Germany and England, published a report, in 1843, encouraging the use of oralism in the United States.¹ As a result, parents of deaf children demanded that the oral method be adopted as methodology for teaching communication skills.

Oralism, today, is usually called the aural-oral approach since speech, speechreading, reading, writing and auditory training are all components of this methodology. Speechreading is sometimes referred to as 'lipreading'. Pahz and Pahz (1978) state that,

unfortunately, 40 to 60% of English speech sounds cannot be distinguished. For example, mama, papa and bye-bye result in the same lip formations. Auditory training attempts to develop sound/speech awareness through the combined use of the individual's residual hearing and amplification. One must keep in mind that a defective auditory mechanism receives distorted sound signals and amplification only increases the volume of the distortion.

Joseph Gordon (1892), noted that National College for the Deaf recommended a "combined system". This methodology was thought to be the forerunner of Total Communication. Total Communication is defined as the simultaneous use of sign and speech. The combined system, however, first exposed the deaf individual to oralism. If s/he failed, manual communication was then employed.

The emphasis on Total Communication evolved after the 1965 Babbidge Report. This publication commented on the failure of the oral method in American education of the deaf. The study by Schein and Bushnaq (1962) indicated that only 1.7% of the deaf population enter college. Additional research by Boatner (1965) and

McClure (1966) reported 1) 30% of deaf students were functionally illiterate, 2) 60% were at or below 5.3 grade level, and 3) of the 5% who attained tenth grade level or better, most were either hard of hearing or possessed acquired rather than congenital hearing losses.

A study by Donald Moores provided additional support for Total Communication. He stated that the simultaneous presentation of multiple stimuli increases the intelligibility of the message for the deaf individual.

Glenn Lloyd (1978) comments on the fact that until the deaf child becomes proficient in the "language of education", in this case, English, can learning begin. Sign language provides the means for mastery of the language of education.

Current Status of CAI - Sign Language Research

Sims and Clymer (1985) summarized the history of the development of computer-aided instruction for the hearing impaired. The literature covers both CMI (computer-managed instruction) and CAI (computer-assisted instruction) as well as (computer)

programs for Speech Reading and Sign Language. CMI was defined as a data base designed to record student progress and provide information regarding further direction the learner should take in his/her study. By contrast, CAI is an instructional program. Sims and Clymer list five

attributes of CAI which are as follows: 1) individualized instruction, 2) feedback and branching, 3) record-keeping capacity, 4) graphics capabilities and 5) linkage with external devices e.g., a VTR (video tape recorder) for interactive video. The authors go on to say that CAI lessons are usually one of four styles.

The first of these is drill and practice. This CAI usually includes exercises that reinforce a skill.

Tutorials are "complete instructional modules". The authors list five elements that should be present within this design: "1) objective(s), 2) presentation of concepts, 3) drill and practice, and 4) subsequent analysis of performance."

Another style relative to CAI is that of games. This design is similar to that of drill and practice.

However, fantasy may be involved and the activity might be quick and competitive.

The last design that, very often, incorporates interactive video, is simulation. A situation is presented for which the learner must make a decision. Consequences are then displayed.

An additional contribution that Sims and Clymer make are their comments relative to researching CAI. The authors make a number of recommendations with regard to research which involves CAI vs. more conventional (teaching) methods. An N of 100-200 would provide for ecological validity. Random assignment is also important. Sims suggests that rather than gain scores response time should be the dependent variable. The goal of CAI courses, is mastery at a high performance level. Because response time is related to lesson difficulty, it can be used to measure skill acquisition. Individuals may attain similar performance levels or gain scores irregardless of the methodology utilized. The efficiency of producing the responses, however, may vary as a result of exposure to the different methods.

With the introduction of interactive video in CAI, sign language training has become more of a reality. Attempting to teach signs using illustrations and/or graphics (in a computer program) has its limitations especially when one takes into consideration that orientation and movement are essential to sign reproduction. Rochester Institute of Technology has developed DAVID, Dynamic Audio Video Instructional Device. Finch, Bohli and Schmieder (1985) presented, in narrative and through diagram, the hardware and the electrical configuration necessary to make the DAVID program for teaching sign language work. Basically, the configuration consists of a monitor, an Apple computer and VTR all of which are commonplace pieces of equipment. In addition, the BCD Videolink, interfaces the computer with the VTR to allow videotapes to be used as part of the interactive CAI program. Such a hook-up permits CAI via a visual motion media. In the Basic Sign Communication Course participants, at the National Technical Institute for the Deaf (NTID) can make the selection as to whether they wish to study new sign vocabulary or grammatical principles (of sign language). Either of these is presented with signs in

1) isolation, 2) within the context of sentences, or 3) within the context of paragraphs. Feedback, for learner input, is immediate. All of the above is described via a (sign language lesson) flow chart. Care was taken to sequence the tape so as to keep search time to a minimum.

The authors provided considerable amount of information and detail regarding (videotape) production guidelines. Emphasis is placed upon the fact that the hearing-impaired rely on visual stimuli as an information source. This section of the Finch, et al., paper then goes on to explain how the tape is 'addressed' by the videolink.

Newell, Sims and Myers (1983) discussed, in greater detail, the development of DAVID. This article begins by listing and providing approximate costs for the hardware necessary for running CAI with interactive video. The software was produced at NTID using an authoring system. The authors emphasized the fact that care must be taken with regard to sequencing the lesson; that is, the videotape segments must be arranged so as to limit the amount of access times. Users may interpret extended access times as mechanical

failure. Newell, then, goes on to describe DAVID and narrate a brief history of its development. The three practice levels are, again, reiterated: 1) individually, 2) within a sentence and 3) paragraph comprehension. If the learner selects 'practice' from the menu, s/he views an explanation of (sign) grammatical principle(s), the sign in isolation and, finally, within the context of a sentence. Student responses regarding sign recognition are requested periodically throughout the practice section. Feedback is immediate. 'Paragraph comprehension' can then be chosen by the user. Three paragraphs are displayed followed by comprehension questions. The authors conclude by listing three advantages of DAVID: 1) user-friendly, menu-driven, 2) learner responses are always optional; that is, the program can be viewed without interruption, and 3) practice start and end points are at the discretion of the student. It is the hope of the authors that limitations such as access time and authoring programs that allow few question styles will be reduced as technology advances. It is unfortunate that, at the present time, no research has been conducted related to DAVID. William Newell of

Rochester Institute of Technology (RIT), per letter, stated that no statistical research regarding DAVID has been done and there are no immediate plans to do so.

The topic of sign language instruction using CMI is covered in Grosman, Siders and Garraway's (1983) publication. The authors introduce the article by describing a limitation of foreign language classes - instruction is not individualized. Not unlike any other language instruction, sign training must include opportunities for practice. Likewise, traditional language classes do not check as to whether or not previously learned material has been 'mastered'. New terms (signs) are introduced. Individualized and 'mastery' learning are the goals of this CMI program entitled "Sign Teacher". Sign Teacher requires the presence of a scorer who shapes a variety of signs (receptive practice) and observes the learner reproducing signs upon request (expressive practice). (Learner) sign formations are evaluated on the basis of the following: 1) sign placement, 2) hand-shape, 3) movement, 4) palm and fingertip orientation, 5) contact point and 6) linguistic content. The work by Grosman

enables the reader to appreciate the amount of visual stimuli to be perceived when learning a sign.

As part of the program, verbal and sign responses are coded and, then, this particular CMI program "1) makes teaching decisions, 2) makes instructional judgments 3) collects information, 4) analyzes and interprets information and 5) communicates the assessment information for individual use". The learner can obtain a hardcopy of information regarding progress and suggestions for further study.

There is a project, under the direction of Susan Rose, at the University of Minnesota dealing with interactive CAI and Sign Language. Per telephone conversation, Dr. Rose explained that the purpose of this investigation is to examine information processing capabilities of youngsters when sign language is the content and CAI interactivity is the protocol. The study attempted to establish the fact that there is a high correlation between scores on the Bender Gestalt and Embedded Figures Test with the rate of mastery using interactive CAI.

Computer Aided Instruction
Principles of Instructional Design

Gagne (1981) discusses five learning outcomes which could, successfully, involve CAI as the teaching methodology. The outcomes and corresponding levels of Bloom's taxonomy are listed below:

TABLE 3

Bloom's Taxonomy - Corresponding Learning Outcomes

OUTCOME	TAXONOMY
Verbal information	Comprehension
Concrete concept	Knowledge
Defined concept	Knowledge
Rule	Application
Problem solving	Application

Once the lesson objective has been reviewed and the learner performance defined, the type of outcome can be determined.

Gagne also makes mention of the fact that the type of CAI will determine how many learning events need to be included in the (computer) program. Gagne and Briggs (1979) list nine such events. They are as follows:

1. Gain attention. The learner must focus on the monitor. This is one instance where graphics come into play. The authors suggest that the attention getting format "relate directly to the content".
2. Inform learner of objectives. Lesson objectives should be displayed to inform the CAI user of the content area and how his/her performance will be measured. A sample question, presented immediately following the objective, is recommended.
3. Active prior knowledge. The CAI should start at a point where recall of prior knowledge is stimulated. The transition from old to new information is then smoother.
4. Present information. The lesson is paced and the content is presented with the learner's skills in mind.
5. Guide learning. Prompts should be incorporated in the design for use when the individual makes an error. Incorrect responses can be branched to a brief remedial lesson. The length of response time can be limited by the computer

program. That is, if the learner cannot answer within a specified amount of time, the remedial lesson appears.

6. Elicit responses. A drill and practice opportunity should be included in the CAI allowing the user to demonstrate newly acquired skills.
7. Provide feedback. During the practice segments, the individual should be informed of the accuracy of his/her responses.
8. Assess performance. Assessing the learner's ability to meet the objective provides the designer with a means by which the success of the CAI can be determined.
9. Promote transfer. Review of earlier CAI should be provided in subsequent lessons. The future lessons should incorporate the main concepts of prior CAI.

Drill and simulation, most likely, will not involve all nine events. Tutorials, on the other hand, will. Additional suggestions for a good CAI lesson include allowing the learner to pace the lesson, stimulus control on an individual screen and making the

program 'user friendly'. A major limitation of CAI is the fact that it cannot be used for higher level learning outcomes such as analysis, synthesis and evaluation (judgment) is noted here.

Harless (1986) and Harless, Zier and Duncan (1986) describe interactive CAI which is voice-activated, i.e., VERBAL responses are made by the user. The computer program advances on the basis of these responses. This interactive CAI deals with a 'patient' admitted, on an emergency basis, for medical treatment. The videotape covers his stay and any examinations/tests/procedures that the medical student may request. The final outcome, e.g., the patient is discharged, he expires, etc., is probability-based. Appropriate medical management will result in a successful outcome. Inadequate or inappropriate management decreases the 'probability' of success. The author makes mention of the fact that this (computer) program provides both formative and summative feedback. An example of formative feedback would be a situation during which the user must make a medical decision. The result of that decision appears on the videotape immediately. A final, summative evaluation which

includes 1) "correctness of final diagnoses, 2) correctness of discharge plan, 3) percentage of critical information obtained during interaction with the case, 4) danger/discomfort index for tests and procedures ordered, 5) costs incurred by the patient...and length of hospital stay and 6) appropriateness and effectiveness of crisis intervention" is presented at the conclusion of the program. The previous article commented on the limitations of CAI regarding higher level learning outcomes. Keeping these articles in mind, it is thought that, perhaps, in time, more complicated, higher level learning can go on with interactive CAI. Technologically-advanced devices can make simulation more realistic; analysis- and even judgment-type responses could be requested of the learner.

Computer-Aided Instruction Guidelines

Julie Vargas (1986) reviews five principles in her article discussing effective CAI. They are as follows:

1. The frequency of opportunities for learner response is important. Studies have shown that achievement is higher for students who are

actively involved as opposed to those who are passive participants such as in a lecture situation.

2. Appropriate stimulus control is another issue. Cueing, when it is giving the answer away, does nothing for learning.
3. Immediate feedback for a particular response, another recommendation for effective CAI, should occur prior to the next answer.
4. "Linear programming" or "successive approximation" is also suggested. That is, information should be presented sequentially so that the learner can build upon knowledge previously acquired.
5. Motivation is an important point. If the user does not experience success while proceeding through the CAI program, it is likely that s/he will become discouraged and, as a result, reluctant to use the program.

Unlike the various forms of media for classroom use, the computer allows the student to become directly involved in his/her own learning. However, unless the program is effectively designed, CAI will be a worthless method for instruction.

A paper by Caccamise, Meath-Lang and Johnson (1981), was written in response to the data obtained by a Vision Task Force appointed in 1976, at NTID. This group was organized in view of the fact that the hearing impaired are mainly VISUAL learners.

Recommendations, listed in this particular publication, regarding lighting and stance for sign language training can also apply to the videotape production.

They are as follows:

1. Signing: There should be a distance of no greater than 30 feet between the signer and the audience. A viewing angle of 0-60 degrees toward the thumb side of the signer's dominant hand" is recommended.
2. Lighting: Proper lighting originates above or in front of the speaker/signer. A light source situated behind the speaker/signer results in silhouettes.
3. Backgrounds: Solid, contrasting colors are recommended. Efforts should be made to reduce/eliminate glare/reflections. For example, yellow chalk produces less glare than white. Signs having a black or dark background

with a white foreground is best. There are those, while unable to distinguish between colors, who can, however, distinguish among highly contrasting shades of the same color.

Computer-Aided Instruction Evaluation Techniques

The formative evaluation of instructional materials occurs during the development process. In the case of CAI, there are unique characteristics that must be considered during the formative evaluation process. Hardware dependent materials such as CAI software is not portable. Printed materials, on the other hand, can be taken aside and examined for 'patterns' in student responses, comments with regard to level of content difficulty, etc. CAI, however, can be programmed to generate hardcopies of scores, response times, etc. Golas (1983) describes three formative evaluation settings: 1) one-to-one, 2) small group and 3) field tests. In the case of the one-to-one, there should be two evaluative procedures. The first should be with a 'script'; that is, the student should read through the frames of a CAI program and revisions made prior to programming the lesson on

the computer. Developing a CAI program alone is quite time-consuming and modifications can be difficult due to branching. Working through the flowchart in this manner allows the programmer to make as many revisions as necessary in the least amount of time.

The second evaluation technique can be done as the learner works through an actual CAI lesson. Branching may lead the learner, depending on the response made, to skip a section that may be poorly designed or lack sufficient information.

The CAI program can then be reviewed by a small group, usually no more than three individuals. Their data and comments can provide information regarding the need for modifications in the CAI.

Golas does not recommend field tests of CAI due to the costs for conducting such full-scale assessments. During a field test, however, management problems may surface requiring the production of supplemental material, e.g., a user's guide.

After CAI has been reviewed point-by-point, a summative evaluation can be conducted. A summative evaluation might be carried out during the field test or after a period of time during which the CAI was used

with a number of students. The summative evaluation attempts to measure the effectiveness of the program.

Cohen's (1983) article, listing the issues considered in the summative evaluation of CAI, first makes the distinction between evaluating microcomputer courseware and all other instructional media. CAI can serve in three unique capacities in the classroom: 1) supplement the curriculum, 2) act as complete course unit, or 3) as CMI. When considering the functions of CAI, a special evaluation checklist must be developed. The points to be reviewed in a CAI program include content sequence; e.g., does the learner have access to a 'menu' by which s/he can exit/enter any lesson or is the teacher able to 'individualize' instruction by sequencing a program for a particular student. The issue of 'attractive' presentation is mentioned; i.e., the amount of text per screen should be such that viewing will not be difficult and graphics (visual stimulation) should be included within the content as a learning aid. Cues should be utilized but only when keeping in mind that as mastery increases, 'fading' occurs. How much control does the user have over CAI; can s/he enter at any point/exit at any time, are

"Help" screens present, can s/he determine rate of presentation by moving ahead only when depressing a specific key and so on? The article lists a number of suggestions regarding feedback. Immediate, non-threatening, serving to remediate and relevant are some of the characteristics for the appropriate use of feedback. Teacher/student manuals should be included with the (computer) program to provide technical information for the instructor and to reduce confusion/fear for the learner. The CAI program should be designed so as to limit the time for 'loading' and 'searching'. Time spent waiting for the system only decreases user interest.

Scriven initiated the concept of "goal-free evaluation". A lesson should not be assessed on the basis of the objective alone. Scriven defines an educational evaluation as beginning with an "establishment of a need through the assessment of the effects to a determination of the cost-effectiveness and the likelihood of continued support".

Despite the fact that there is no mention of Scriven's product evaluation, Zemke's (1984) article looks at the assessing the value, in terms of

practicality and user outcomes, that should be made when evaluating CAI. Performance in field trials, consumer performance and performance comparison must be considered. Cost-effectiveness and the availability of extended support were, likewise, discussed.

Zemke mentions the fact that the Federal government is designing a CAI 'buyer's guide'. Any commercially produced CAI program will be assessed on four points: 1) documentation, 2) content accuracy, 3) general design, and 4) program. The guide will recommend that the purchaser review "publisher's validation, technical validity of content and design documentation". Zemke continues by presenting the following (evaluation) check-list which came about after questioning a number of CAI developers:

1. "Does the program actually teach anyone anything?"
2. "Are the mechanics clean?"
3. "Does the program take advantage of the computer's interactive capabilities?"
4. "Does it use instructional techniques appropriately?"
5. "Does it provide appropriate feedback?"
6. "Is the program flexible?"
7. "Does the program promote mastery?"
8. "Is it motivating?"

Both the external and internal facets of a particular CAI program must be evaluated. An example of an external aspect might be the graphics; the sequential presentation of the material, on the other hand, internal. Content, attractively presented, is more easily mastered. If there is an insufficient amount of feedback, how is the learner motivated? CAI has opened up a realm of learning opportunities. Only when the design features are applied is CAI successful.

Information Processing Capabilities

Jean Piaget is, undoubtedly, the most widely recognized proponent of the cognitive theory of development. The theory states that an individual's mental activity involves both assimilation and accommodation. Every mental process assumes the interpretation of the environment to one's existing system (assimilation). Accommodation forces the learner to alter his/her mental processes in light of new experiences. Another way of defining assimilation is the "incorporation of sensory data into existing intellectual patterns". Adjusting these "intellectual patterns" to the sensory data is accommodation. These

"patterns" are labelled by Piaget as "schemes". Schemes become cognitive strategies; i.e., if a scheme is utilized in a particular learning situation, the individual will employ it again in similar situations.

Wittrock (1979) applied this cognitive approach to instructional methodology. The mental processes that intervene between presentation of stimuli and learning are called "information processing model". The information processing model assimilates the stimuli presented to the learner. The instructional designer should keep in mind the processing skills of the individual when considering the methodology to employ for a particular content area.

An article by Snow (1977) suggests that instructional designers consider 1) the cognitive processes involved in a learning task and 2) the perceptual skill level of the individual. Instructional methods should be selected so as to reduce any discrepancies between skill level and processes required.

Ruth Bovy (1981) argues that the "location of the processing of a learning task defines the function, type, and extent of the instructional method required

for individual students". She is a proponent of the cognitive approach whereby sensory stimuli is interpreted by the learner.

Bovy cites two circumstances. First, the instructional selection is based on processing skills that are intact but the individual cannot apply the cognitive processing activity to the learning task. The instructional method must then "direct" the activity. Problem solving, for example, would assist the learner in orienting his/her cognitive processing ability.

Second, in the case where the individual lacks the processing skill, she recommends "prescriptive instructional programs" whereby a lesson is designed such that the learner will pull as much cognitive assistance as needed to complete a learning task.

An example, relative to the second case, is Salomon's (1979) investigation of the effects of modifications in instruction on directing cognitive processes. After assessing the attending behavior of eighth graders, some were exposed a teaching methodology whereby details within an illustration were zoomed in and out. The display was presented without

cues for the control. Those with poor attending skills benefitted from the modified display but not from the control. The opposite results occurred for those with good attending skills.

Bovy concludes by stating that, in both the above-mentioned instances, computer programs can meet the need for "individualized instruction".

In signing, language concepts are conveyed through the use of visual images. An individual's visual perception skills come into play when comprehending a signed message.

Treisman (1979) proposed the theory of feature integration whereby an individual scans an image and "encodes it along a number of dimensions, e.g., color, orientation, spatial frequency, etc". This is sometimes defined as visual integration, the first stage in visual processing. Treisman's theory is the basis for Winn's (1982) discussion.

"Visual processes and strategies are exemplified by imagery and feature recognition, where properties of stimuli, such as form, spatial arrangement, and so on, influence how information is processed. Perceptual processes have to do with integrating features into complete visual displays, and are largely automatic".

Winn, later, questions whether or not these processes are truly "automatic". He encourages research dealing with feature integration when more complex images are presented in instruction. He also suggests studies, involving children and handicapped individuals as subjects, to examine the means by which they integrate features.

The next visualization process is that of "assimilation" or the "interaction of new and existing knowledge". An example relative to visual assimilation is determining the amount of similarity between two visual displays. Suggestions for research, here, must center around those (instructional) techniques "that indicate what schema new knowledge is to be assimilated to, and how that knowledge is to be processed".

Jay (1983), in his article, attempted to match computer software design with human information processing capacities. The five, which should be considered when defining objectives and determining strategies, include 1) memory, 2) language, 3) graphics, 4) "cognitive characteristics of the user", and 5) feedback. The discussion relative to memory deals with the concept of 'short-term memory'. An

example of memory as applicable to CAI is the amount of text per screen: only one idea presented on each screen. The learner should be provided the opportunity to advance through the program at his/her own pace. Modules should be no more than 15-20 minutes in length; the student should be given the chance to 'exit', periodically, during the program.

Language level is determined by the information that needs to be absorbed and the (language) skill level of the learner. Define any new vocabulary and avoid coding that non-comforming e.g., "yes" or "no" not 1 or 0. Language training should be a in a multiformat presentation - audio and video.

Jay's one purpose for graphics in a (computer) program is to "enhance memory". The use of colors, arrows, blinking words, etc. all function as 'attention getters'. A visual image can serve as a mnemonic device.

When considering the "cognitive characteristics of the user", the author makes reference to Piaget's developmental growth of reasoning.

Piaget lists three periods in the development of intelligence. The first is sensorimotor during which

time the child notes that s/he is an object among objects. The second is that of preoperational thought. This period is characterized by the child's categorizing the objects within his/her environment. The third is labelled concrete operations. It is at this stage in one's intellectual development that inferences can be made about the objects. The fourth and final stage is formal operations. The child can now hypothesize or reason deductively.

Even if a mastery approach is taken, the program designer must keep in mind the pre-requisite skill level of the learner(s).

Feedback should be immediate, if possible, or delay kept to a minimum. Before informing the student of an error, hints should be provided. S/he should be told that performance will be evaluated. In the case of interactive video, search time can be misinterpreted as a mechanical failure if the student is not informed.

Jay recommends computer software be designed with the above-mentioned cognitive processes in mind.

Summary of the Literature and Related Research

The previously mentioned literature offers guidelines and suggestions for the development of CAI. Other articles describe existing CAI incorporating those principles (of instructional design) and guidelines. Recommendations, from authors such as Sims, Bovy and Winn, however, include the assessment of information processing capacities and CAI mastery rate as a dependent variable. Earlier publications have been descriptive rather than statistical in nature and, as a result, leave this area of investigation lacking data that could determine whether or not CAI (or interactive CAI) is the methodology that facilitates learning within a variety of content areas.

Footnotes

1J.A. Pahz, C.S. Pahz and Glenn T. Lloyd, Total Communication (Springfield: Charles C. Thomas, 1978), p. 23.

CHAPTER III
DESIGN AND METHODOLOGY

Introduction

The review of the literature reveals that the majority of the publications have been descriptive rather than statistical in nature. Thus, there is no evidence to lead one to conclude that interactive CAI would facilitate learning when sign language is the content.

Recommendations from authors such as Sims, Bovy and Winn, however, include the assessment of information processing capacities and CAI mastery rate as a dependent variable. As a result of the above observations, the major intent of this study is to provide valid, empirical data that would assist practitioners in the field to make important decisions concerning the implementation of interactive CAI in the acquisition of signing skills.

The purpose of this investigation is to examine information processing capabilities when, with sign language as the content, interactive CAI is the protocol.

Hypotheses

The following null hypotheses will be tested in the investigation:

1. There is no significant correlation between an individual's score on the Embedded Figures Test and interactive CAI mastery rate when sign language is the content.
2. There is no significant correlation between an individual's score on the Embedded Figures Test and video presentation mastery rate when sign language is the content.
3. There is no significant correlation between an individual's score on the Revised Minnesota Paper Form Board Test and interactive CAI mastery rate when sign language is the content.
4. There is no significant correlation between an individual's score on the Revised Minnesota Paper Form Board Test and video presentation mastery rate when sign language is the content.
5. There are no significant differences in performance among subject/treatment groups on the receptive identification quiz scores.
6. There are no significant differences in performance among subject/treatment groups on the expressive signing scores.

Description of the Sample

A total N of sixty-eight adult learners served as subjects in this experiment. Thirty-two subjects were characterized as those having a manifest interest for sign language. Students enrolled in sign language

classes at a south suburban Chicago community college and an adult education program sponsored by a special education cooperative i.e., neighboring school districts merged in an effort to provide maximum services for the handicapped, made up this group. The remaining thirty-six individuals were employees of the Department of Mental Health/Developmental Disabilities; including administrative, professional and direct care staff.

Given the pool of subjects, they were randomly assigned to one of two treatment groups and one control group. Treatment one consisted of those receiving training via computer-based interactive video while treatment two consisted of training via media (videotape). The control group received training using traditional sign language training method.

Enrollment in a sign language class constituted assignment in the subject group having a "manifest interest for sign language". It was assumed, by the investigator, that registering for a such a class indicative of a desire and/or need to learn the content. "Others" included individuals who were willing to give of their time to participate in the

study. While a few may have expressed interest in the content, others were curious with regard to computer-aided instruction.

The researcher felt that, despite the fact that these two samples were biased, generalizability of results would not be restricted to a particular socio-economic background. One must, however, keep in mind how quasi-experimental research threatens internal and external validity. Campbell and Stanley (1966) comment that random assignment does not necessarily eliminate all threats to internal validity. Below, each is listed in addition to means taken to reduce that threat:

1. History: Dependent variable measurement was made immediately after the treatment had been administered.
2. Testing: Subjects participating in this research were not exposed to repeated testing.
3. Instrumentation: The Revised Minnesota Paper Form Board test and the Embedded Figures Test were selected due to the fact that scoring procedures were objective. Responses on the receptive identification sign quiz were also objective. Sign approximations on the expressive signing test, however, were judged, by the investigator, on their proximity to the actual signs.
4. Statistical regression: The formation of the control group or the traditional classroom method attempted to alleviate this threat. Assignment into the control group was random.

5. Mortality: Exposure to the treatments occurred only once. There was no loss of subjects over time.
6. Diffusion or imitation of treatments: The subjects included members of one class and employees from one worksite. These individuals participated at different times. Thus, communication, among the subjects, relative to the various treatments might have occurred.
7. Compensatory rivalry: Due to the fact that the participants received treatments on an individual basis scheduled over a period of two months, the investigator cannot be sure that some degree of competition among subjects did not take place.
8. Resentful demoralization: The researcher did not provide any information regarding the quality of treatments. However, discussion among the subjects might have occurred.

Bracht and Glass (1968) list two threats to external validity, namely, "experimentally accessible population vs target population and interaction of personological variables and treatment effects" (p. 438). It has been emphasized in previous chapters that this particular investigation concentrated on the adult learner. Thus, any discussion with regard to the results will concentrate on that population only. Efforts to reduce the possibility of the second threat to external validity included the assignment of individuals from one subject group to either treatment or control groups.

The analytic paradigm, below, illustrates the breakdown of treatment and subject groups.

	Treatment 1	Treatment 2	Control
Sign Language	N = 10	N = 10	N = 12
Others	N = 12	N = 12	N = 12

Figure 1

Description of Treatment Method

Computer-Aided Instruction - Treatment Group 1

The 'video' portion of this computer assisted instruction evolved from a videotape produced by the media department of the Jacksonville State School for the Deaf located in the state of Illinois. Twenty-four signs in the topical area of food (appendix B-I) are shaped by the interpreter. The production of each sign is demonstrated via front and side views. This videotape is 'linked' to a computer program which was designed using the McGraw-Hill Interactive Authoring System (appendix C-I). The participants in Treatment Group 1 reviewed a 'manual' (appendix D-I) prior to

booting (starting up) the program. The (computer) program includes three sections: 1) "Tutorial", 2) "Drill and Practice" and 3) "Quiz". The interactive CAI is 'menu-driven', thus, providing the subject with the option to repeat the "Tutorial" and/or "Drill and Practice" sections if so desired. The tutorial is structured such that the program will branch after a series of three signs. The branch will present the opportunity to review those just learned in the tutorial.

In addition to the interpreter, the printed term also appeared on the screen. All aural and oral cues and visual stimuli other than the sign reproductions were eliminated for the "Drill and Practice" and "Quiz" sections. The printed term and the interpreter's face were blocked out by means of a character generator. The audio portion was also deleted. Upon completion of the quiz, the (computer) program terminates.

Pilot Testing Results

Six students, from Loyola University's School of Education participated in the pilot-study. These individuals proceeded through the computer-assisted

instruction. Each was asked to complete the evaluation form (appendix E-I) at the conclusion of the interactive CAI.

All the participants expressed a similar criticism: the videotape "search time" between screens was often too long. Unfortunately, this could not be remedied. The video screens were arranged so as to reduce search time as much as possible. The use of videodiscs would all but eliminate this problem. The cost effectiveness, however, for this research precludes obtaining such equipment.

The results indicated three deficiencies/problematic areas in the program: 1) additional and/or clarification of directives were needed on certain screens; 2) the beginning address of the initial video screen in the "Drill and Practice" and "Quiz" sections required that the frame number lowered; 3) originally, the interactive CAI did not block out the interpreter's face --- information, that could possibly skew data, was supplied via 'lip-reading'. These deficiencies were rectified.

Video Presentation - Treatment Group 2

An alternate version of the videotape is utilized for this treatment. The twenty-four signs are presented in sequence but with no opportunities for review. The 'computerized' quiz is included in this treatment. However, the computer program is altered such that immediately after the subject logs on, the "Quiz" section appears (appendix C-VI). In effect, the videotape serves as the instructional medium.

Traditional Method - Control Group

The same twenty-four signs are demonstrated in a fashion similar to that presented by the videotape by the investigator in a traditional classroom setting. In addition, photocopied illustrations of the signs (appendix F-I) were distributed to the subjects. On the paper, the sequence of the sign movements are represented by arrows. If two different hand positions are required, the starting position is shown by means of dashed lines. The final position is drawn with solid lines. 'DM' and 'SM' are sometimes printed next to a particular (sign) illustration indicating that the movement is either double or single motion. These

drawings are mirror images, i.e., they are presented as the deaf individual would view them. It is also assumed the learner is right-handed. The origin of the sign is explained as this functions as a mnemonic device for retaining new material in this content area (Riekehof, 1983).

Receptive Sign Quiz

Traditionally, sign language students are tested on receptive sign identification skills or, in other words, the ability to 'read' signs reproduced by another. In this study, the subjects were asked to identify each sign after it had been shaped by the interpreter (investigator). The signs selected for the 'traditional' receptive identification quiz (appendix G-I) were the same as those formed by the interpreter during the 'computerized' quiz used in treatments one and two.

Expressive Signing Quiz

In an effort to help determine which treatment best aids in the integration of the new material into the old, an expressive signing quiz was administered by the investigator to both treatment groups and the

control. An example of the type of expressive question is: "A beverage you get from the kitchen faucet". The learner is expected to form the sign for water. (See appendix H-I.)

Mastery Rate

Sign comprehension is a three step process. One first observes the visual image, translates or interprets the image and, finally, reacts to the message. The amount of time between the reception of the sign and the interpretation, in addition to the receptive sign identification (computerized quiz) score is, relative to this investigation, labelled as 'response time'. McGraw-Hill Interactive Authoring System has the capacity to record the time needed to respond to a question screen. This data was recorded in an effort to determine which treatment is the most efficient in terms of productivity.

The receptive sign identification and expressive signing scores measure performance level. These scores, in addition to the response time, make up the 'mastery rate'.

procedure

The procedures used for the both treatments and control groups were organized as follows:

1. Subjects, in Treatment Groups 1 and 2, were given the Embedded Figures Test and the Revised Minnesota Paper Form Board Test.
2. Subjects participated in the training consistent with the assigned treatment group.
3. Subjects completed the receptive portion of the sign language (skill) assessment.
4. Subjects completed the expressive portion of the sign language (skill) assessment.

Instrumentation

When considering instruments for evaluating perceptual functioning skill level and spatial aptitude, a number of assessment tools were reviewed. The Embedded Figures Test (EFT) is the most widely recognized instrument for assessing perceptual functioning. The manual states that the EFT specifically measures one's "ability to break up an organized visual field in order to keep a part of it separate from that field" (p. 4). The cognitive-style

theory is cited, by Witkin et al, as the rationale for using the EFT as a measure of perceptual functioning. The manual defines cognitive styles as "characteristic, self-consistent modes of functioning which individuals show in their perceptual and intellectual activities" (p. 3). The "schemes", as described by Piaget in the preceding chapter, relate closely to these cognitive styles. That is, the EFT measures the degree to which an individual possesses an "intellectual pattern" for the interpretation of signs.

Jay (1983), in his article, attempted to match (computer) software design with human information processing capacities. Based on Jay's article, one of the five abilities which should be taken into account when defining objectives and determining strategies was "cognitive characteristics of the user" (p. 23). When discussing the "cognitive characteristics of the user", Jay makes reference to Piaget's developmental growth of reasoning: sensorimotor, preoperational thought and concrete and formal operations are the four stages of intellectual growth. Even if a mastery approach is taken, the program designer must keep in mind the pre-requisite skill level of the learner(s). The EFT

reliabilities are reported as being between .61 to .90. For the group most comparable to the subjects used in the present study, the reliability is .82.

Three instruments were considered for the measurement of spatial aptitude: Bender-Gestalt, Wechsler Adult Intelligence Scale (WAIS) (Block Design and Object Assembly sub-tests) and Revised Minnesota Paper Form Board Test (RMFB). This investigator hesitated to utilize the Bender-Gestalt as scoring is subjective. Buros' "Mental Measurements Yearbook" states that, when WAIS sub-tests are administered individually, test-retest reliability decreases. Anne Anastasi (1968) rates the RMFB as one of the best tests for spatial aptitude. The manual describes this particular test as an assessment of "those aspects of mechanical ability requiring the capacity to visualize and manipulate objects in space" (p. 3).

Norms for the RMFB are based on educational and industrial samples. Investigations of the test's validity indicated that the RMFB can differentiate between groups that differ in spatial and mechanical ability and thus, assist in the determination of educational/vocational aptitude. Alternate-form

test-retest reliability coefficients range from .71 to .78.

The 'computerized' receptive identification and expressive signing quizzes utilized in the present study, were created keeping in mind the guidelines for question writing. While styles of questions were varied, i.e., multiple choice and fill-in-the-blank, only those requiring objective responses were used. The response selections for the multiple choice questions were chosen such that a particular one would not be so obviously correct or incorrect. A limitation of interactive video is tape search time. That is, the time required to search for specific information. The search time placed some restrictions on those responses thus limiting the number of multiple choice questions.

The expressive signing quiz presented every query in an assimilative manner. Since the subjects were 'beginning sign' students, they tended to reproduce an approximation of the sign required for the correct response. The expressive signing quiz questions were designed to exclude the possibility of another sign answer similar in orientation and movement. For

example, the signs for "jam" and "jelly" were never requested as they differ only in their final positions.

Design and Statistical Analysis

A total of 68 adults participated in the study. A completely randomized factorial design (CRF-pq) was used, consisting of two experimental treatment groups and the control group.

The initial data can be categorized into independent and dependent variables as illustrated in Tables 4 and 5, respectively. Following each table are comments as to how the specific variables were treated statistically.

TABLE 4

Independent Variables Description

VARIABLES	DESCRIPTION/CODE
Treatment Group	Coded: Group 1 = CAI Group 2 = Video Group 3 = Control
Sex	Female = 1; Male = 2
Age	Chronological age
Subject Description	Coded: 1 = manifest interest for sign language 2 = others

Frequency distributions were completed for the above-mentioned independent variables. Had the number of males participating in this research been comparable to that of females, differences in mastery rate might have been considered based on sex. While the majority of the subjects were between the ages of 20-50, chronological age, relative to this investigation, was not considered. The literature lists wide breakdowns of age ranges for adult learners when discussing performance. The mean age was calculated for descriptive purposes.

TABLE 5-A

Dependent Variables Description

VARIABLES	DESCRIPTION/CODE
Receptive Signing Level	Raw score on the receptive identification quiz
Expressive Signing Level	Raw score on the expressive signing quiz
Response Time	Receptive identification quiz response time

TABLE 5-B

Additional Variables

VARIABLES	DESCRIPTION/CODE
Perceptual Functioning Level	Raw score on the <u>Embedded Figures Test</u> ; (Mean solution time per item)
Spatial Aptitude Level	Raw score on the <u>Revised Minnesota Paper Form Board Test</u> ; (Right - Wrong/5)

Statistical analysis performed to test the null hypotheses consisted of using an ANOVA procedure among the receptive identification and expressive signing quiz scores to determine if differences in the

dependent measures among treatment and control groups were significantly different. This statistical technique allows for analysis of interaction effects among variables.

The Pearson product-moment coefficient (Pearson r) was calculated between EFT and RMFB scores and mastery rate to determine whether or not a correlation exists between those variables. The mastery rate included, in addition to the receptive identification and expressive signing scores, response times for the quiz questions. Thus, the possibility of correlations between the each of the two test instruments and performance as well as efficiency levels were explored.

Summary

This study will attempt to provide statistical evidence as to whether or not interactive CAI would facilitate learning when sign language is the content. Perceptual functioning and spatial aptitude levels will also be examined within this experimental situation.

Two categories of subjects were randomly assigned to treatments one and two and the control group in an attempt to eliminate or reduce threats to internal and

external validity. Only test instruments requiring objective responses were selected to measure the information processing capabilities. A pilot-study, on the computer-assisted instruction, revealed problematic areas that were rectified so as not to skew the results.

In conclusion, every possible effort has been made so that the results of this investigation are sound.

CHAPTER IV
RESULTS AND DISCUSSION

Introduction

As previously stated, the purpose of this investigation was to examine information processing capabilities when, with sign language as the content, interactive CAI is the protocol. Instructional methodologies were reviewed as were subject groupings.

This chapter is divided into two major sections. The first section provides a demographic examination of the final sample. Correlational studies, comparing subjects' scores on the Embedded Figures Test and the Revised Minnesota Form Board test with age were completed on this sample to determine whether or not the information was consistent with the literature. The second, divided into six sub-sections, reports and discusses the results related to each of the hypotheses tested. These discussions are based on Pearson r , ANOVA and t-testing performed within the context of the six hypotheses.

A Demographic Examination of the Final Sample

The demographic variables examined in this study included age

and sex. Other variables considered were subject description, perceptual functioning and spatial aptitude levels. These variables are depicted in Figure 2.

The analytic paradigm, below, has been altered to illustrate the cell census, including the breakdown of N:

	Treatment 1 (CAI)	Treatment 2 (Videotape)	Control (Traditional)
Sign	N = 10 Females = 8 Males = 2 X Age=33.34 X EFT=51.60 X RMFB=33.4	N = 10 Females = 10 Males = 0 X Age=29.84 X EFT=45.20 X RMFB=40.00	N = 12 Females = 12 Males = 0 X Age=34.14
Language			
Others	N = 12 Females = 11 Males = 1 X Age=43.48 X EFT=61.00 X RMFB=30.8	N = 12 Females = 11 Males = 1 X Age=42.56 X EFT=48.08 X RMFB=35.75	N = 12 Females = 11 Males = 1 X Age=39.26

Figure 2

For the purposes of review, treatment 1 consisted of computer-aided instruction using interactive video for the presentation of a sign language lesson. Individuals in treatment 2 were exposed to a sign

language videotape. Treatment 3 included participation in a (traditional) classroom. Subjects included in treatments 1 and 2 were administered the Embedded Figures Test (EFT) and the Revised Minnesota Form Board test (RMFB) prior to their participation in either interactive CAI or the videotape lesson. The literature states that, although the relationship between test scores (for both instruments) and age are low, it is an inverse relationship; i.e., younger individuals score higher than the older. The results of Pearson r analyses relating Embedded Figures Test and Revised Minnesota Form Board test scores to age revealed that no relationship existed.

Chronological ages, as reported in the literature, spanned a wider developmental range than the present research. Elementary levels through adulthood were used in the studies cited in the Embedded Figures Test and Revised Minnesota Form Board test manuals. The present investigation concentrated on the adult learner. Specifically, the youngest subject was 18 years of age while the oldest was 63.42 years. The majority of the sixty-eight participants were between

the ages of 20-50. Only four were under 20 years of age; eight were over 50 years.

Only 7.4% of the population in this study were male. This number (N = 5) is too small to take in account in this study.

TABLE 6

Pearson Correlation Coefficients for Age/Sex

	Treatment 1 (CAI)	Treatment 2 (Videotape)
Sign	EFT/Age:p=.480 NS	EFT/Age:p=.184 NS
Language	RMFB/Age:p=.34 NS	RMFB/Age:p=.41 NS
Others	EFT/Age:p=.150 NS	EFT/Age:p=.262 NS
	RMFB/Age:p=.45 NS	RMFB/Age:p=.49 NS

In conclusion, age was not found to be significantly related to the variables perceptual functioning level (Embedded Figures Test) and spatial aptitude level (Revised Minnesota Form Board test) as indicated in Table 6. Therefore, these variables were not pursued in further statistical analyses.

Results Related to Testing Null Hypothesis #1

Null Hypothesis #1: There is no significant correlation between an individual's score on the

Embedded Figures Test and interactive CAI mastery rate when sign language is the content.

In order to test the above-mentioned hypothesis, a Pearson coefficient was used to analyze the data. As previously discussed, the Embedded Figures Test assesses perceptual functioning. Thus, it was thought that scores on the Embedded Figures Test could determine if a particular individual's visual perception skills were sufficient for processing information as presented via interactive video or videotape.

The Pearson correlation coefficient procedure suggested one significant relationship for those subjects possessing a manifest interest for sign (subject group 1) and exposed to interactive CAI (treatment 1). The (inverse) directionality is characteristic for and due to scoring on Embedded Figures Test; the lower the mean solution time per item, the higher the perceptual functioning level. The direction/degree for the trend related to the expressive signing scores was reversed and lower in magnitude. Table 7, below, illustrates these results. It should be mentioned again that only one portion of

the results is tabled since these are the most important findings.

TABLE 7

Pearson Correlation Coefficients for Embedded Figures Test/Treatment 1, Subject Group 1

DEP. VARIABLE	CORRELATION COEFFICIENT	SIGNIFICANCE
Response Time	-.4958	p = .073
Receptive Identification Score	-.3488	p = .162 NS
Expressive Signing Score	.1415	p = .348 NS

The results in table 8 for those subjects participating as study volunteers (subject group 2) and exposed to interactive CAI (treatment 1), demonstrated a slight, negative tendency between Embedded Figures Test and expressive signing scores and between Embedded Figures Test and receptive sign identification scores. This inverse relationship can once again be attributed to Embedded Figures Test scoring procedures. The direction for the (computerized quiz) response times are reversed indicating a slight, positive trend.

TABLE 8

Pearson Correlation Coefficients for Embedded Figures Test/Treatment 1, Subject Group 2

DEP. VARIABLE	CORRELATION COEFFICIENT	SIGNIFICANCE
Response Time	.3085	p = .165 NS
Receptive Identification Score	-.3047	p = .168 NS
Expressive Signing Score	-.3322	p = .146 NS

If the above-mentioned tendencies were significant, one could conclude that, perhaps, in the case of the positive direction, interactive CAI could compensate for weaknesses in perceptual functioning. On the other hand, the inverse direction of the coefficient might serve as a gauge of one's success with interactive CAI. In summary, the findings do support the rejection of Null Hypothesis #1.

Results Related to Testing Null Hypothesis #2

Null Hypothesis #2: There is no significant correlation between an individual's score on the Embedded Figures Test and video presentation mastery rate when sign language is the content.

To test the above-mentioned hypothesis, a Pearson coefficient was also used to analyze the data. This procedure demonstrated one statistically significant relationship: a positive tendency between the expressive signing scores and the Embedded Figures Test. On the other hand, the results of Pearson coefficient did not indicate significant findings for the dependent variables 'response times' and 'receptive identification scores'. (See table 9.)

TABLE 9

Pearson Correlation Coefficients for Embedded Figures Test/Treatment 2, Subject Group 1

DEP. VARIABLE	CORRELATION COEFFICIENT	SIGNIFICANCE
Response Time	.0999	p = .392 NS
Receptive Identification Score	.2298	p = .262 NS
Expressive Signing Score	.5587	p = .047

By contrast, those subjects participating as study volunteers (subject group 2) and exposed to the videotape lesson (treatment 2), demonstrated a slight, negative tendency for (computerized quiz) response

times and receptive sign identification scores. However, none are statistically significant. This inverse directionality is expected in view of the Embedded Figures Test scoring procedures. The directionality for the expressive signing scores indicate a slight, positive trend. These results are depicted in table 10:

TABLE 10

Pearson Correlation Coefficients for Embedded Figures Test/Treatment 2, Subject Group 2

DEP. VARIABLE	CORRELATION COEFFICIENT	SIGNIFICANCE
Response Time	-.0063	p = .492 NS
Receptive Identification Score	-.0513	p = .437 NS
Expressive Signing Score	.2611	p = .206 NS

The results from Table 9 showing the one significant relationship between Embedded Figures Test and expressive signing scores should be addressed. Two issues must be considered to better understand the findings. First, this significant finding appeared within the results for those subjects having a manifest

interest for sign. This population may possess sufficient fundamental signing skills to successfully complete the quiz regardless of the treatment. Second, Riekehof (1983) points out that for the novice signer his/her sign reproduction skills develop more quickly than those for reception of other's signs. In conclusion, Null Hypothesis #2 can be rejected.

Results Related to Testing Null Hypothesis #3

Null Hypothesis #3: There is no significant correlation between an individual's score on the Revised Minnesota Paper Form Board Test and interactive CAI mastery rate when sign language is the content.

As a brief review, the Revised Minnesota Form Board test measures spatial aptitude. It was thought that perhaps scores on the Revised Minnesota Form Board test would be indicative as to how well an individual might do when exposed to teaching methodology involving two-dimensional, moving images such as those demonstrated via interactive video or videotape.

The Pearson correlation coefficient did not suggest any significant relationships among the variables. The results, for those subjects possessing

a manifest interest for sign (subject group 1) and exposed to interactive CAI (treatment 1), indicated only a slight, positive tendency between the response times on the computerized quiz, receptive sign identification and expressive signing scores.

On the other hand, the results, for those subjects participating as "others" (subject group 2) and exposed to interactive CAI (treatment 1), demonstrated a moderate, negative tendency between the response times for the computerized quiz and the Revised Minnesota Form Board test. The direction for the receptive sign identification and expressive sign scores are reversed, indicating a moderate, positive trend. These results are depicted in table 11:

TABLE 11

Pearson Correlation Coefficients for Revised Minnesota Form Board/Treatment 1, Subject Group 2

DEP. VARIABLE	CORRELATION COEFFICIENT	SIGNIFICANCE
Response Time	-.3805	p = .111 NS
Receptive Identification Score	.4259	p = .084 NS
Expressive Signing Score	.4084	p = .094 NS

If the above-mentioned tendencies were significant, one could conclude that perhaps in the case of the negative direction, interactive CAI maybe compensates for limitations in spatial aptitude skills. The positive coefficient suggests that Revised Minnesota Form Board test scores might serve as a gauge of one's success with interactive CAI. However, the insignificant findings cannot support the rejection of Null Hypothesis #3.

Results Related to Testing Null Hypothesis #4

Null Hypothesis #4: There is no significant correlation between an individual's score on the

Revised Minnesota Paper Form Board Test and video presentation mastery rate when sign language is the content.

This procedure did not indicate any significant relationships. However, the results, for those subjects possessing a manifest interest for sign (subject group 1) and exposed to the videotape lesson (treatment 2), indicated slight, negative trends for response times and expressive signing scores. As can be seen from the results in Table 12, Null Hypothesis #4 cannot be rejected.

TABLE 12

Pearson Correlation Coefficients for Revised Minnesota Form Board/Treatment 2, Subject Group 1

DEP. VARIABLE	CORRELATION COEFFICIENT	SIGNIFICANCE
Response Time	-.2217	p = .269 NS
Receptive Identification Score	.0234	p = .474 NS
Expressive Signing Score	-.1552	p = .334 NS

Discussion

Null Hypotheses #1 and #2 were not rejected in view of the fact that significant relationships were indicated between the Embedded Figures Test and the (computerized quiz) response time and the expressive signing score. Null Hypotheses #3 and #4 were rejected because there were no significant correlations between the Revised Minnesota Form Board test scores and the (computerized quiz) response time, the receptive sign identification and the expressive signing scores.

Larger cell sizes would certainly have yielded relationships that were significant. The Alpha level of 0.075 was used as the criterion for this study. Use

of higher levels would result in a type I error whereby the researcher rejects the null hypothesis when it is true. While literature will suggest an Alpha level of 0.05, the risk of a type I error in this investigation has increased by only 2.5%. Kirk (1982) states that increasing sample sizes would be the safer option. The following two tables show the various cell combinations.

TABLE 13

Pearson Correlation Coefficients for Embedded Figures Test

CELL COMBINATION	DEP. VARIABLE	SIGNIFICANCE TABLE
(A, B, C, D)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS
(A, B)*	Receptive Ident	NS
	Expressive Sign	p = .012
	Response Time	NS
(C, D)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS
(A, C)*	Receptive Ident	p = .043
	Expressive Sign	NS
	Response Time	NS
(B, D)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS

*(Code for Tables 13 and 14)

A: Treatment 1, Subject Group 1
 B: Treatment 2, Subject Group 1
 C: Treatment 1, Subject Group 2
 D: Treatment 2, Subject Group 2

TABLE 14

Pearson Correlation Coefficients for Revised Minnesota
Form Board test

CELL COMBINATION	DEP. VARIABLE	SIGNIFICANCE TABLE
(A, B, C, D)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS
(A, B)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS
(C, D)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS
(A, C)*	Receptive Ident	NS
	Expressive Sign	p = .041
	Response Time	p = .051
(B, D)*	Receptive Ident	NS
	Expressive Sign	NS
	Response Time	NS

*(Code for Tables 13 and 14)

A: Treatment 1, Subject Group 1
 B: Treatment 2, Subject Group 1
 C: Treatment 1, Subject Group 2
 D: Treatment 2, Subject Group 2

Tables 13 and 14 revealed that the occurrences of significant correlations are few. The significant relationship in Table 13 is present in Table 9. The significant correlations in Table 14 strengthen the

moderate in Table 11. One might conclude that both instruments - the Embedded Figures Test and the Revised Minnesota Form Board test are possible correlates with an individual's success when sign language is the content and/or interactive CAI is the protocol. On the other hand, subject pool is too low to produce significance.

Results Related to Testing Null Hypothesis #5

Null Hypothesis #5: There are no significant differences in performance among subject/treatment groups on the receptive identification quiz scores.

Table 15 presents the receptive sign identification mean scores for each subject/treatment group expressed as percent correct. These results reveal that highest score was achieved by those subjects having a manifest interest for sign and receiving the traditional classroom method (control). On the other hand, the lowest performance was obtained by those individuals lacking the manifest interest for sign and exposed to the videotape lesson (treatment 2).

TABLE 15

Comparison of Receptive Identification Mean Scores for
Experimental and Control Groups

	Treatment 1 (CAI)	Treatment 2 (Videotape)	Control (Traditional)
Sign Language	X = 96.00 SD 6.47	X = 89.60 SD 15.30	X = 98.67 SD 2.98
Others	X = 86.42 SD 14.54	X = 82.17 SD 17.67	X = 91.67 SD 14.06

A two-way analysis of variance was used to determine whether or not the receptive sign identification scores were statistically significant with regard to Null Hypothesis #5. The table below presents these results:

TABLE 16

Analysis of Variance of Receptive Identification Scores

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P
Main Effects	2138.079	3	712.693	4.398	.007
Category	1074.921	1	1074.921	6.634	.012
Treatment	1985.020	2	492.510	3.039	.054
2-Way Interactions	21.414	2	10.707	.066	.936
Category Treatment	21.414	2	10.707	.066	.936
Explained	2159.492	5	431.898	2.665	.030
Residual	10046.317	62	162.037		
Total	12205.809	67	182.176		

Statistically significant differences exist in the main effects of Treatment and Subject Group (Category) on receptive sign identification scores. However, no statistically significant differences exist in the 2-way interaction, Subject Group (Category) by Treatment, on receptive sign identification scores.

In order to determine the source for the significant main effects, t-tests were performed among treatments 1 and 2 and the control group with the receptive sign identification scores as the dependent variable. The t-test compares the differences between

two means and will not reveal the magnitude or strength of the relationship. These results are depicted in Table 17:

TABLE 17

t-test Results for Treatments 1, 2 and the Control Group Using Receptive Identification Score as the Dependent Variable

GROUP	MEAN	S.D.	T-VALUE	2-TAIL SIG.
Treatment 1 (CAI)	90.77	12.85		
			1.23	0.226
Treatment 2 (Videotape)	85.55	15.28		
			-2.43	0.020
Control (Traditional)	95.17	10.98		
			-1.24	0.221
Treatment 1 (CAI)	90.77	12.85		

Table 17 reveals a significant difference, in the mean receptive sign identification scores, between treatment group 2 (videotape presentation) and the control (traditional). The mean differences between treatment groups 1 (interactive CAI) and 2 and between 1 and 3 were not statistically significant. Therefore, the main effect in the two-way for treatment is due to

differences between the video presentation and control groups.

As a result of the two-way analysis, as presented in Table 16, Null Hypothesis #5 was rejected.

Results Related to Testing Null Hypothesis #6

Null Hypothesis #6: There are no significant differences in performance among subject/treatment groups on the expressive signing scores.

Table 18 depicts the expressive signing mean scores for each treatment. These results suggest that highest score was attained by those subjects lacking the manifest interest for sign and receiving the control traditional classroom method. The lowest score, on the other hand, was achieved by those lacking a manifest interest for sign and who were exposed to the videotape (treatment 2).

TABLE 18

Comparison of Expressive Signing Mean Scores for
Experimental and Control Groups

	Treatment 1 (CAI)	Treatment 2 (Videotape)	Control (Traditional)
Sign Language	X = 96.00 SD 4.00	X = 88.50 SD 12.93	X = 97.25 SD 5.21
Others	X = 93.25 SD 8.79	X = 84.08 SD 18.86	X = 97.92 SD 5.01

An two-way analysis of variance was used to determine whether or not the expressive signing scores were statistically significant with regard to Null Hypothesis #6. Table 19, below, presents these results:

TABLE 19

Analysis of Variance of Expressive Signing Scores for
Experimental and Control Groups

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P
Main Effects	1675.464	3	558.493	4.523	.006
Category	72.823	1	72.823	.590	.445
Treatment	1579.922	2	789.961	6.393	.003
2-Way Interactions	77.495	2	38.748	.314	.732
Category Treatment	77.495	2	38.748	.314	.732
Explained	1752.975	5	350.595	2.840	.023
Residual	7654.833	62	123.465		
Total	9407.809	67	140.415		

Statistically significant differences exist in the main effect of Treatment on expressive signing scores. On the other hand, no statistically significant differences exist in the main effect of Subject Group (Category) or for the 2-way interaction consisting of Subject Group (Category) by Treatment on expressive signing scores.

Once again, in order to determine the source for the significant main effects, t-tests procedures were carried out on treatments 1 and 2 and the control

group with the expressive signing scores as the dependent variable. These results are revealed in Table 20:

TABLE 20

t-test Results for Treatments 1, 2 and the Control Group Using Expressive Signing Score as the Dependent Variable

GROUP	MEAN	S.D.	T-VALUE	2-TAIL SIG.
Treatment 1 (CAI)	94.50	7.33	2.13	0.042
Treatment 2 (Videotape)	86.09	16.97	-3.05	0.005
Control (Traditional)	97.58	5.23	-1.63	0.112
Treatment 1 (CAI)	94.50	7.33		

The t-test indicates significant differences in mean expressive signing scores between treatment groups 1 (interactive CAI) and 2 (videotape presentation) and treatment group 2 and the control (traditional). There was no significant difference between treatment group 1 and the control.

The results of the two-way analysis suggest that the treatment did affect expressive signing scores. Thus, Null Hypothesis #6 can be rejected.

Analysis of Response Time

As was previously mentioned, McGraw-Hill Interactive Authoring System has the capacity to record the length of time required for an individual to respond to a question. The (computer) program designer denotes whether or not a learner's answer on a particular 'question' screen is to be considered in the evaluation. As a result, the amount of time to fill in the response and the accuracy of that response is recorded by the program. The instructor can then request an account of the scores which would include the percent correct and response times. While no hypothesis was used, this investigation opted to utilize this capacity for further analysis.

Only treatments 1 (interactive CAI) and 2 (videotape presentation) were exposed to this quiz. The sign language interpreter for treatments one and two was the same, thus, the mode of sign reception testing needed to be the same, i.e., the computerized

quiz. The control group was administered a 'traditional' receptive sign identification quiz. The 'traditional' approach used the instructor to shape a series of signs and the participants recorded their answers on paper. The following discussion focuses only on Treatments 1 and 2. The mean response times can be examined in table 21, below.

TABLE 21

Comparison of Response Times for Treatment Groups

	Treatment 1 (CAI)	Treatment 2 (Videotape)
Sign Language	X = 1.39	X = 1.96
Others	X = 2.04	X = 3.27

An analysis of variance was used to determine whether or not the response times scores were statistically significant. Table 22 presents these results.

TABLE 22

Analysis of Variance of Response Times for Experimental and Control Groups

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P
Main Effects	20.013	2	10.007	5.866	.006
Category	10.518	1	10.518	6.166	.017
Treatment	9.495	1	9.495	5.566	.023
2-Way Interactions	1.189	1	1.189	.697	.409
Category Treatment	1.189	1	1.189	.697	.409
Explained	21.202	3	7.067	4.143	.012
Residual	68.237	40	1.706		
Total	89.439	43	2.080		

The ANOVA table indicates that the differences for response times, between treatments 1 and 2, were significant. Likewise, differences between subject groups were also significant.

One can infer, from this analysis that efficiency, as well as performance, was affected by the treatment and subject grouping.

Summary

A few significant correlations or trends, between the dependent variables and scores on the Embedded

Figures Test and the Revised Minnesota Form Board test, were noted in this investigation. Individuals, having a manifest interest for sign language, who participated in treatment 1 (interactive CAI) and treatment 2 (videotape presentation) achieved scores on the Embedded Figures Test that significantly correlated with their success in the learning situations. Subjects, included in treatment 1 (interactive CAI), who volunteered for the present research attained scores on the Revised Minnesota Form Board test that moderately correlated with their success. One can perhaps assume that had N been larger, the EFT and RMFB might possibly serve as measures of one's abilities to learn via interactive video or videotape presentation.

Null Hypotheses #5 and #6 were rejected because of significant findings. Instructional methodology, indeed, did affect response times as well as scores on the receptive sign identification and expressive signing quizzes. Subject Groups, however, had no effect on expressive signing scores.

CHAPTER V

FINDINGS, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Introduction

A major purpose of this investigation was to examine information processing capabilities when, with sign language as the content, interactive CAI is the protocol. Two treatment methods and a control were examined in an effort to determine which instructional strategy facilitates the best performance or when productivity is most efficient, as measured by quiz scores and response times, respectively. In an attempt to determine whether or not one's manifest interest for sign is a contributing factor in performance and productivity, this characteristic was also considered.

A total of 68 individuals were involved in this study. Thirty-two of the participants were (sign language) students from a South suburban community college and from a group sponsored by one of the special education cooperatives. The remainder were made up of either individuals employed by a state facility for the developmentally disabled or other outside contacts. The occupations of the latter included direct care and professional staff

and administrators.

Prior to the experimental treatment, all subjects were administered the Embedded Figures Test (EFT) and the Revised Minnesota Form Board (RMFB) test. This was done in an effort to ascertain whether or not significant correlations existed between scores on the two, above-mentioned instruments and the dependent variables consisting of receptive sign identification and expressive signing scores and response times on a computer quiz.

The experimental procedure included exposure to treatment 1 (interactive CAI), treatment 2 (videotape presentation) or control (traditional (classroom) method). Immediately following the experimental protocol, all participants completed the receptive sign identification and expressive sign tests. The receptive sign identification test for treatment groups 1 and 2 was computerized. Specifically, the computer program has not only the capacity to calculate scores but to tabulate response times. Both these variables were considered when determining the 'mastery rate'. The data were analyzed and each hypothesis was tested with the appropriate statistical tests.

Included in this chapter are the findings and conclusions of this investigation based upon the results presented in Chapter IV, recommendations, suggestions for further research and a summary of the chapter.

Findings and Conclusions

The results from the statistical analyses are as follows:

1) Ho: There is no significant correlation between an individual's score on the Embedded Figures Test and interactive CAI mastery rate when sign language is the content.

2) Ho: There is no significant correlation between an individual's score on the Embedded Figures Test and video presentation mastery rate when sign language is the content.

3) Ho: There is no significant correlation between an individual's score on the Revised Minnesota Paper Form Board Test and interactive CAI mastery rate when sign language is the content.

4) Ho: There is no significant correlation between an individual's score on the Revised Minnesota

Paper Form Board Test and video presentation mastery rate when sign language is the content.

The results, presented in Chapter IV, supported the rejection of hypotheses #1 and #2. A significant negative correlation was noted between the response times and Embedded Figures Test scores for those subjects having a manifest interest for sign language and exposed to treatment 1 (interactive CAI). Thus, one might conclude that the EFT serves as a gauge of one's success with interactive CAI. An significant positive correlation was indicated between the expressive signing and EFT scores for individuals having a manifest interest for sign and participating in treatment 2 (videotape presentation). It might be inferred that the manifest interest for sign language learning compensated for weaknesses in perceptual functioning or for the videotape presentation. (The findings of further statistical analyses did not indicate that videotape presentation was one of the better modes for acquiring sign language skills.) Two factors must be considered at this point. 1) Expressive signing skills do develop at a faster rate than that of sign reception capabilities. 2) Riekehof

(1983) states that signs related to sports and foods are the most natural in formation. Therefore, they tend to be most easily identified.

A moderate trend exists between results on The Revised Minnesota Form Board test and receptive sign identification and expressive signing scores for volunteers exposed to treatment 1 (interactive CAI). If N had been larger, one might be able to assume that the RMFB is a good indicator of success with interactive CAI.

5) Ho: There are no significant differences in performance among subject/treatment groups on the receptive identification quiz scores.

The ANOVA procedure indicated that the differences in the receptive sign identification scores were statistically significant in the main effect of Treatment. This study revealed that significant differences were found between treatment groups as a consequence of the instructional intervention. There was no difference in performance levels between treatments 1 and 2 or treatment 1 and the control. A significant difference between treatment 2 and the control was observed. The absence of a significant

difference in mean receptive sign identification scores achieved by those subjects in treatment 1 and the control add credence to the fact that interactive CAI could substitute for a (traditional) class. The lack of significance in the scores attained by those individuals in treatments 1 and 2 led to further investigation. The receptive sign identification quiz for Treatments 1 and 2 was computerized. Response times, i.e., the amount of time required to 'translate' a sign and type in the (English) word it represented, was tabulated by the (computer) program. Differences in mean response times were significant to the 0.03 level. Thus, while the end product or performance (score) might be equivalent, efficiency was lower for the subjects in treatment 2.

Another query, examined in this research, was whether or not a manifest interest for sign language would affect performance. ANOVA indicated that significant differences in receptive sign identification scores exist in the main effect of Subject Groups. The mean receptive sign identification scores for the two categories were significantly different to the 0.009 level. Subjects 'possessing a

manifest interest for sign language' had to meet one requirement: enrollment in a beginner/basic sign language class. One should consider that the desire and/or need to acquire sign language skills would provide greater initiative to learn. Receptive sign skills are far more difficult to master than expressive and these results suggest that this incentive makes a difference.

Differences, in the 2-way interaction, Treatment by Subject Group were insignificant. Had cell sizes been larger, significance may have been achieved. All sign language training programs, in the South suburban area, were contacted. The majority of the students, enrolled in these classes, willingly participated in this investigation. A few declined because of prior commitments. Due to the fact that the hardware was not portable, one central, testing site was designated and appointment times were arranged. Nevertheless, the findings supported the rejection of the null hypothesis.

6) Ho: There are no significant differences in performance among subject/treatment groups on the expressive signing scores.

The results of the analysis of variance did verify that the expressive signing scores were statistically significant with regard to treatment groups. The t-test procedure was, again, carried out on the mean expressive signing scores. No significant difference was observed between treatment 1 and the control. These findings further support the premise that interactive video could replace the traditional (sign language) lesson. Significant differences were also noted between treatments 1 and 2. The fact that interactive CAI can be designed keeping the pre-requisite skills of the learner in mind and has the capability to be paced by the user should be considered.

Both the ANOVA and t-test procedures failed to reveal significant differences, in expressive signing scores, between subject groups. Three factors need to be reviewed. 1) Expressive sign reproduction develops at a faster rate than sign reception. 2) The characteristic common to food and sports signs that the movement of the sign serves as a mnemonic device should be considered. 3) The cell census was low; larger numbers may have yielded significance. Although the

subject group effect was not sufficiently strong to show significance, higher scores were evident. In summary, Null Hypothesis #6, however, was rejected.

Generalizability of Findings

Upon reviewing the findings, consideration must be given to the limitations inherent in this investigation. The principal delimitation is derived from the fact that this study is limited to interactive CAI which presented signs in isolation only. There was no opportunity for this new knowledge to be assimilated to sentence building. There should be no attempt to generalize to sign language skill development.

The topical area selected for this investigation was concrete in nature - 'foods'. The learner can associate each sign with a distinct, visual image. Results may differ if the interactive CAI included 'verbs', which are more abstract concepts. For example, linking a visual image to the term 'improve' becomes more difficult and may affect retention of the new (sign) material.

Another limitation arises from the nature of the research design. The sample included only adult

learners. One must keep in mind that, while the assignment was random, the sample was not. Another consideration is the possibility that the results might be attributable to the unique characteristics of the adult learner as well as treatment and a manifest interest for sign language. Thus, it cannot be inferred that children will learn at the same rate or in a similar manner. One should keep in mind that authors, such as Moran and Kalakian, affirm that the development of perceptual-motor efficiency corresponds with Piaget's stages of cognitive development.

The effects of interactive CAI on retention of information over time was not examined in this study. Quizzes were administered immediately. The Atkinson-Shiffrin model for memory attributes retrieval from the "long-term store" (LST) to the teaching methodology experienced by the student (Mussen & Rosenzweig, 1973). Tulving and Pearlstone (1966) define learning conditions as the "form of questions asked" or the "number of clues provided".

The comments cited above advocate additional research. Nevertheless, there are several implications

which can be drawn based on the results from the present investigation.

Implications for Practitioners

This investigation has produced evidence that interactive CAI and the traditional (classroom) method were equally effective, in terms of performance levels and efficiency, in acquiring sign language skills. The videotape presentation, a common mode for teaching signs, on the other hand, yielded low outcomes. ANOVA and t-test scores support this conclusion. Differences in scores and/or response times were significant between interactive CAI and the videotape and traditional (classroom) and videotape instructional methodologies. On the other hand, however, differences were insignificant between the traditional (classroom) and interactive CAI. The review of the literature, relative to sign language training with CAI as the methodology, has been descriptive rather than statistical in nature and, as a result, left this area of investigation lacking data that could determine whether or not CAI is the methodology that facilitates learning.

As an example, Gagne lists learning outcomes whereby CAI is successful. Harless designed interactive video for the medical field requiring higher level responses on the part of the learner. Further, software development such as authoring systems allow the program designer to concentrate on the needs of the learner rather than the technical aspects of computer programming. The following recommendations are of practical significance to curriculum designers and sign language instructors relative to decisions involving instructional methodology.

1. Since interactive video users achieved sign language performance levels equal to those participating in the traditional class, computer driven interactive video should be considered as a means by which training can be accomplished. Interactive video can substitute for, not just act as a supplement to, the classroom.

2. Since differences in mean scores and response times were statistically significant favoring the CAI/interactive video, adult education, parent education and teacher training programs in special education should consider purchasing computers and

software. Interactive video should be regarded as a essential part of sign language training.

Suggestions for Further Research

During the course of this study, modifications, in the interactive CAI, and other directions, in the investigation, come to mind. The delimitations mentioned one of the preceding sections, can become extensions of this research.

1. The interactive CAI should be revised in two ways. One would be to include more information, e.g., the origin of the sign or a mnemonic device, to improve recall. The most authoring systems have the capacity to display split-screens. Therefore, the sign reproduction and the information can be presented simultaneously. Another might be to expand the interactive video to include branched programming, i.e., from learning signs in isolation to building sign phrases and/or sentences.

2. The subject area of the interactive CAI might be altered to include 'verbs'. Such data would indicate whether or not interactive CAI would be useful in the retention of abstract concepts.

3. Replication of this study, using a younger sample, would provide data regarding the manner and rate by which children acquire signing skills.

4. Measuring the amount of (sign) recall after an extended period of time might determine the effects of interactive CAI on retrieval of information from long-term memory.

Summary

This study attempted to determine the effectiveness of interactive video on the acquisition of sign language skills. Performance levels attained by subjects included in either the videotape presentation or the traditional (classroom) method were compared with those utilizing interactive CAI.

It may be concluded from the results of this investigation that:

1. No significant differences were indicated, in receptive sign identification performance levels, of those individuals participating in interactive CAI or a traditional (sign language) class.

2. Receptive sign identification performance levels for subjects using interactive CAI were similar

to those viewing the videotape. Efficiency of productivity, however, was significantly lower for videotape presentation.

3. Individuals possessing a manifest interest for sign language achieved higher receptive sign identification performance levels than the 'volunteer' group.

4. The manifest interest for signing was ineffective in increasing expressive signing performance levels.

Incorporation of microcomputers into curriculum design has led to questions regarding the effectiveness of this technology. The role of interactive CAI, when sign language is the content area, was examined here. There is a need for continued research on improving performance and expanding the design so as to build (sign language) skills.

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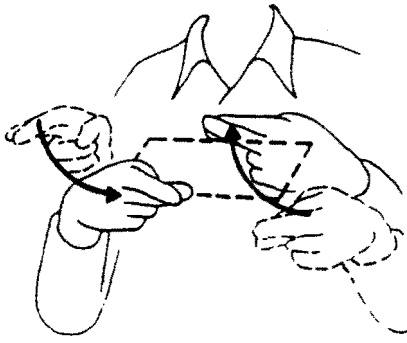
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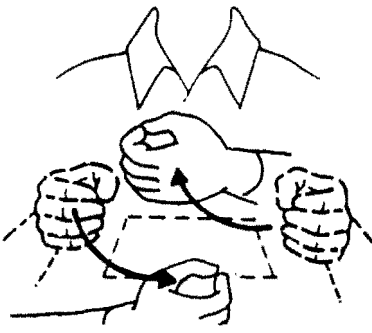
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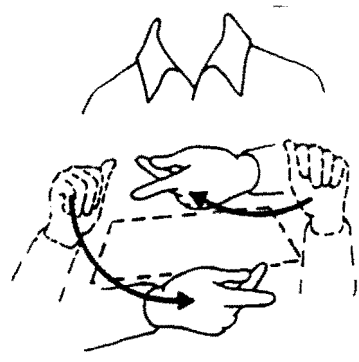
APPENDIX A



room
 R shape both hands, tips out. Turn right R left and left R right to form box shape.



office
 O shape both hands, tips out. Move right O left and left O right, indicating square shape.



apartment
 A shape both hands. Change into P shapes and bring left P behind right P, outlining shape of room.

Sign illustrations taken from:

SIGNING Signed English: A Basic Guide
 by Bornstein & Saulnier

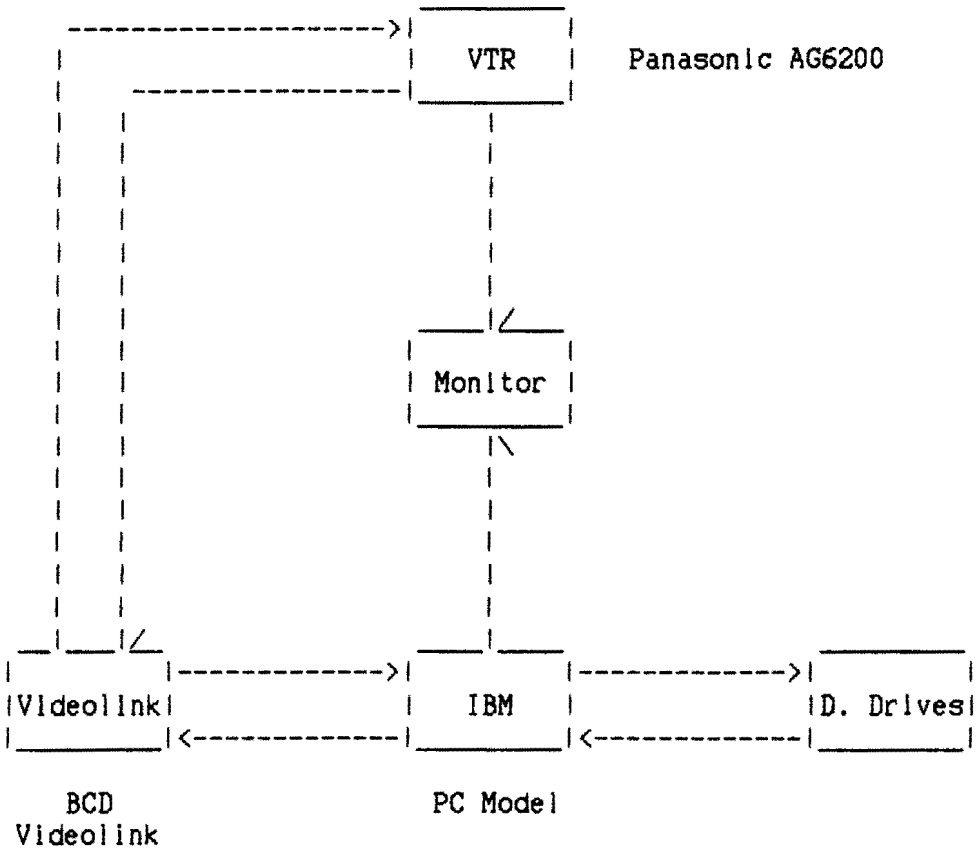
ILLUSTRATION 1

APPENDIX B

SIGN LIST

bacon	Jelly
balogna	juice
bread	pancakes
butter	peanut butter
cereal	pepper
donut	salt
eggs	sausage
French toast	sugar
fruit	syrup
hot chocolate	toast
hot dog	waffle
Jam	water

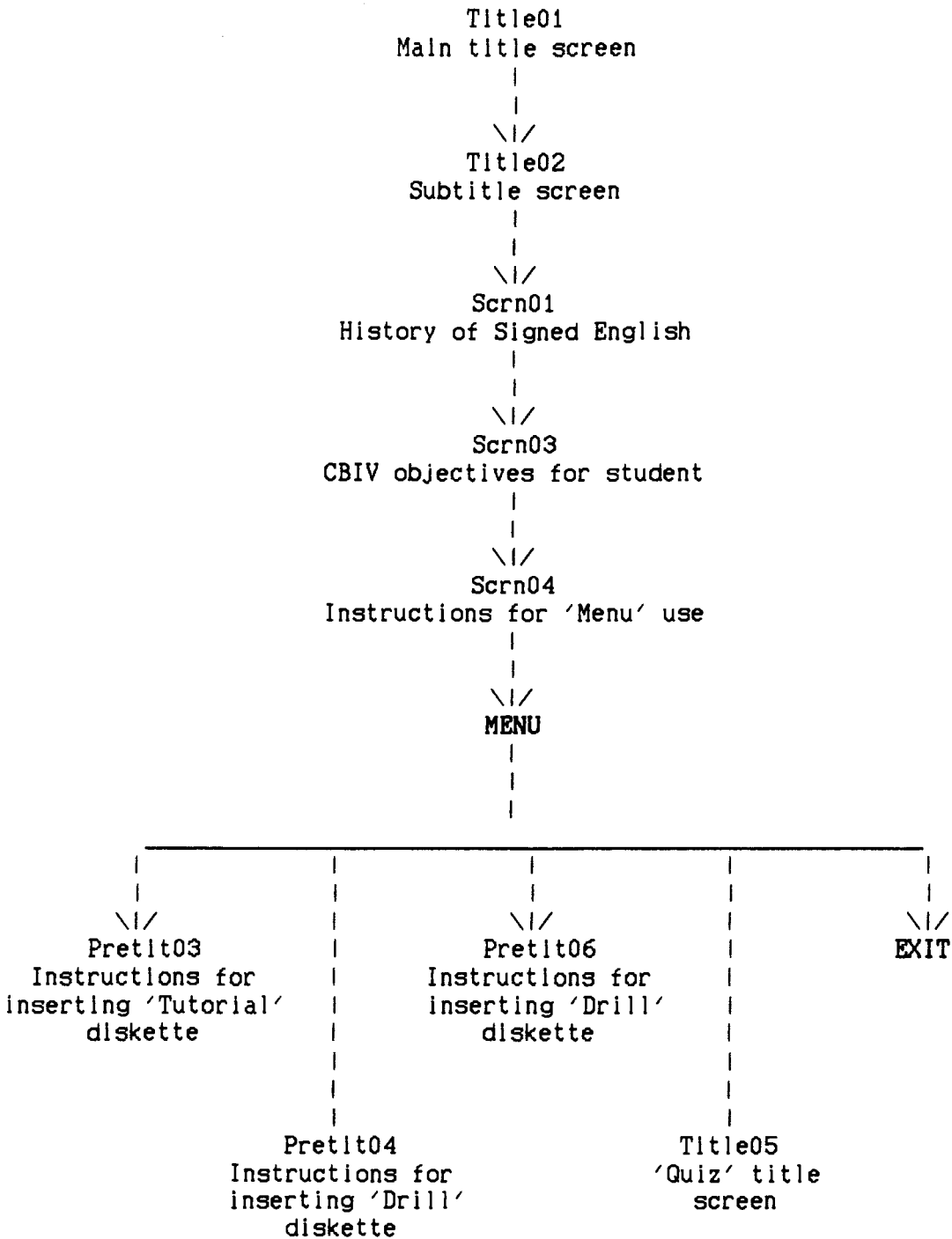
APPENDIX C



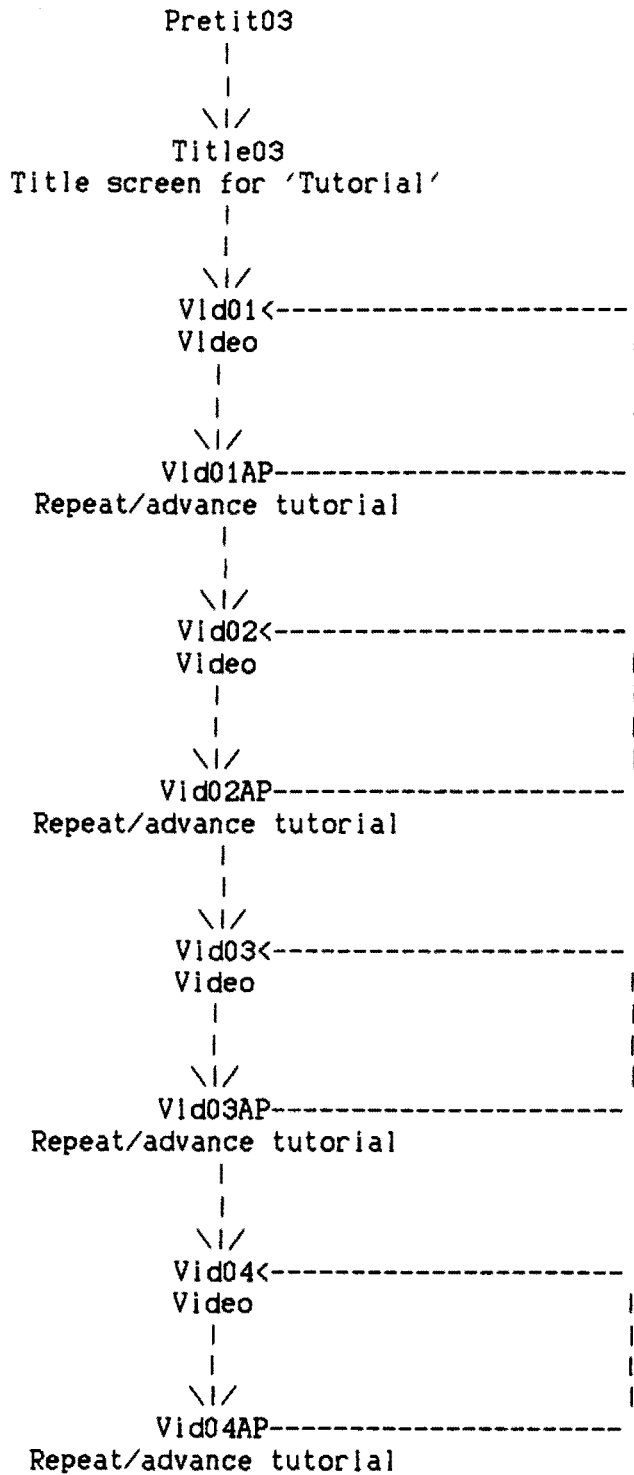
HARDWARE HOOK-UP DIAGRAM

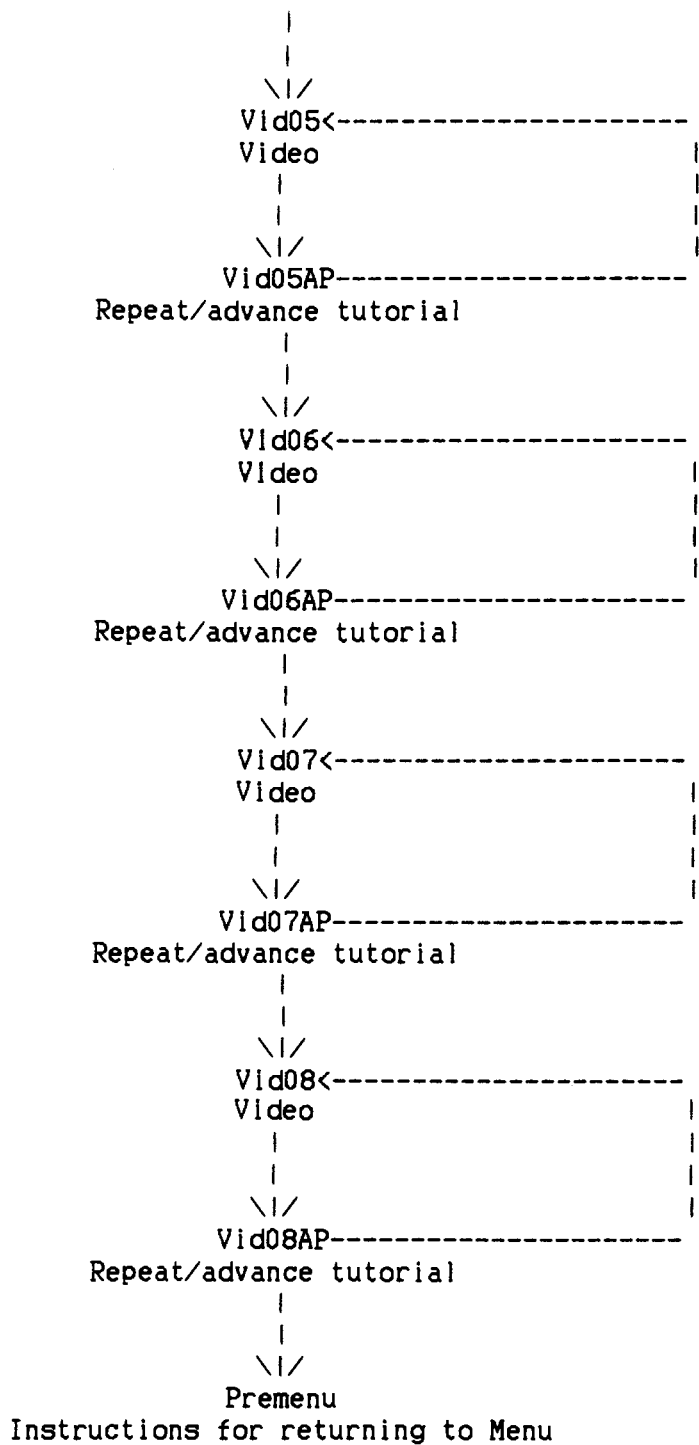
COMPUTER PROGRAM SCHEMA

Treatment 1 INTRODUCTION

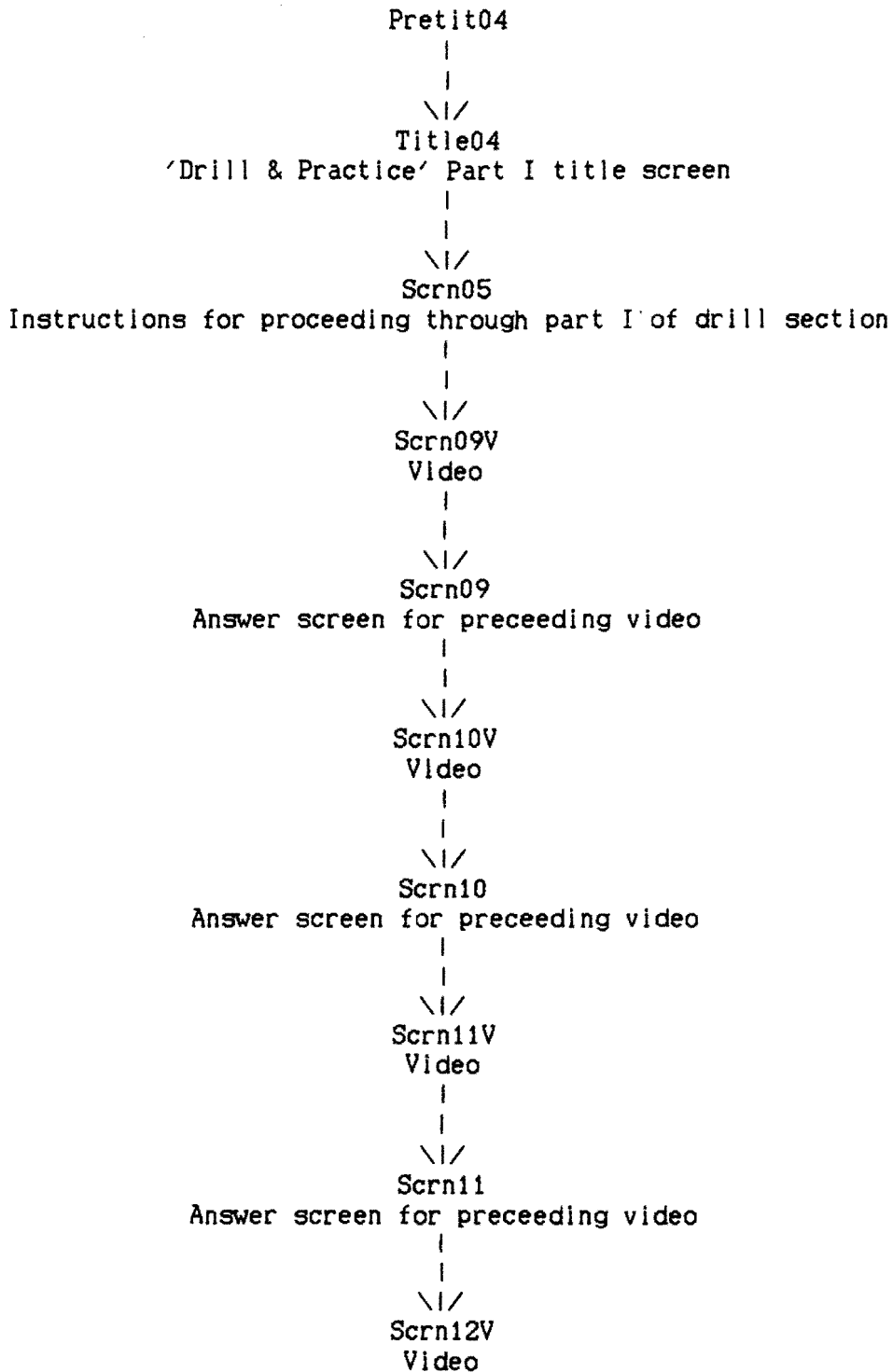


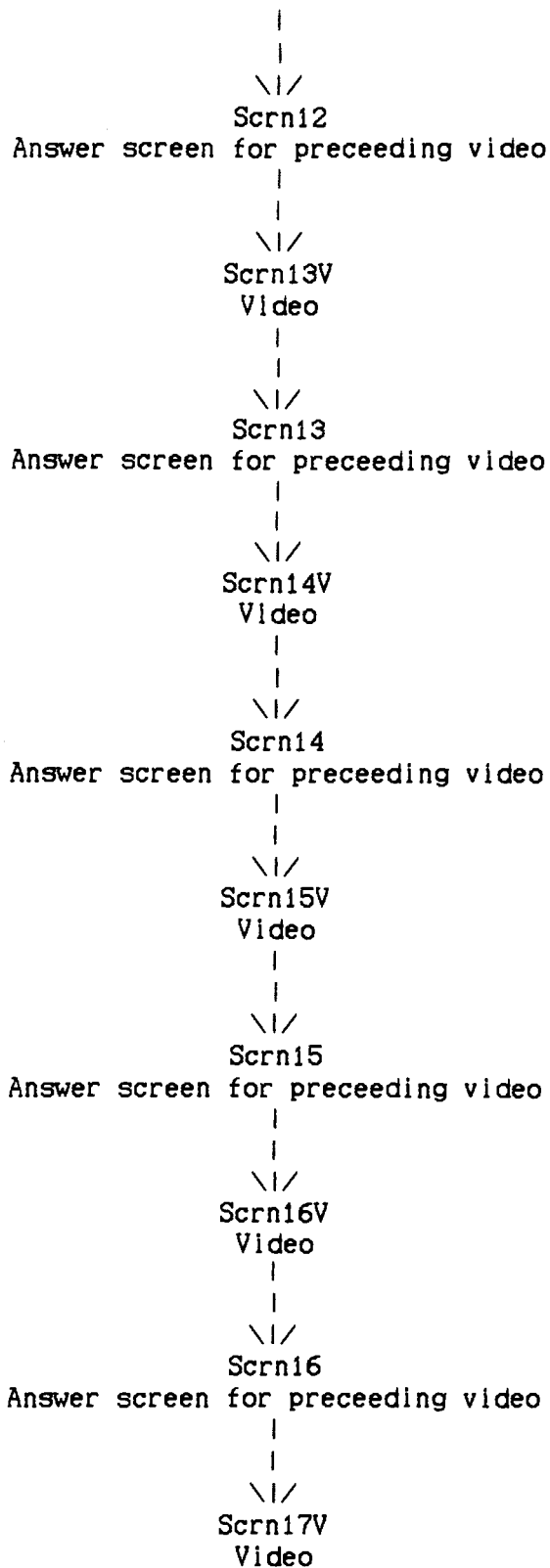
COMPUTER PROGRAM SCHEMA
Treatment 1
TUTORIAL

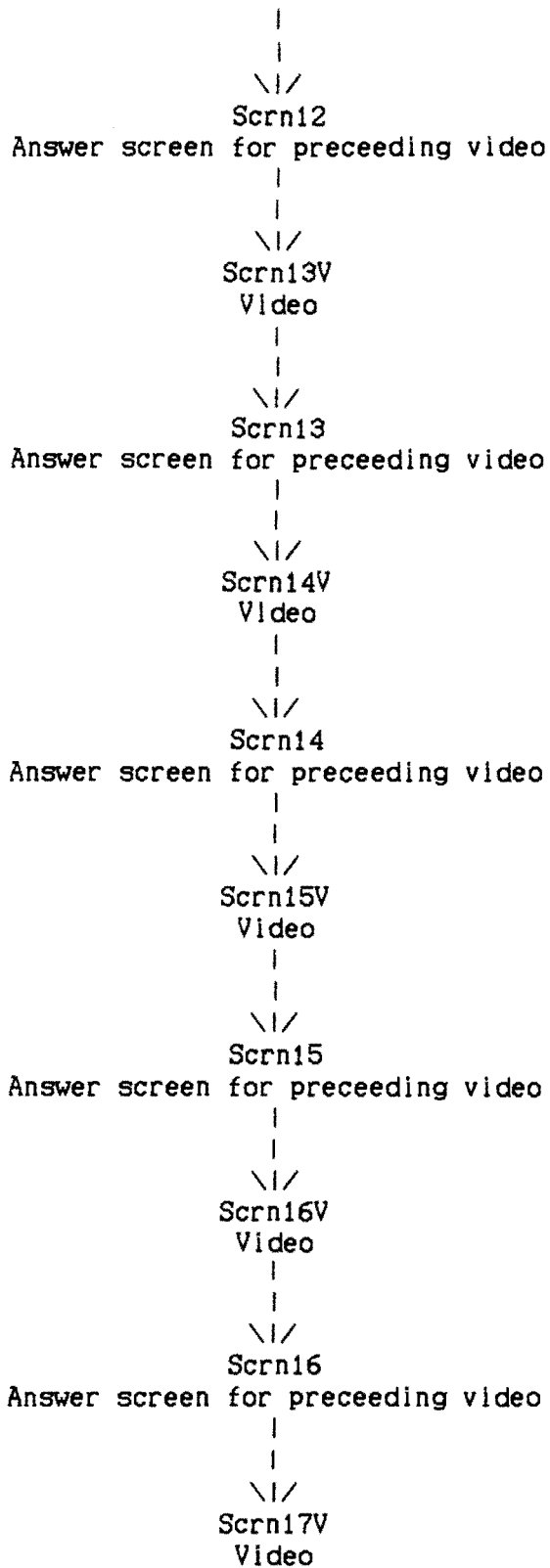


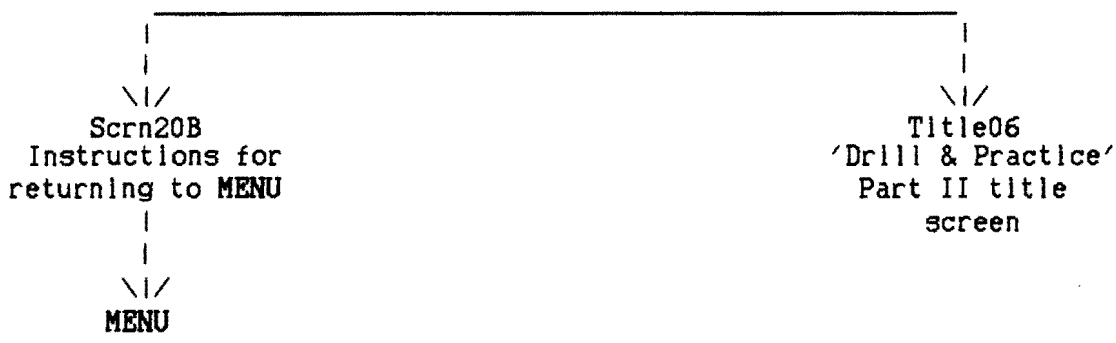
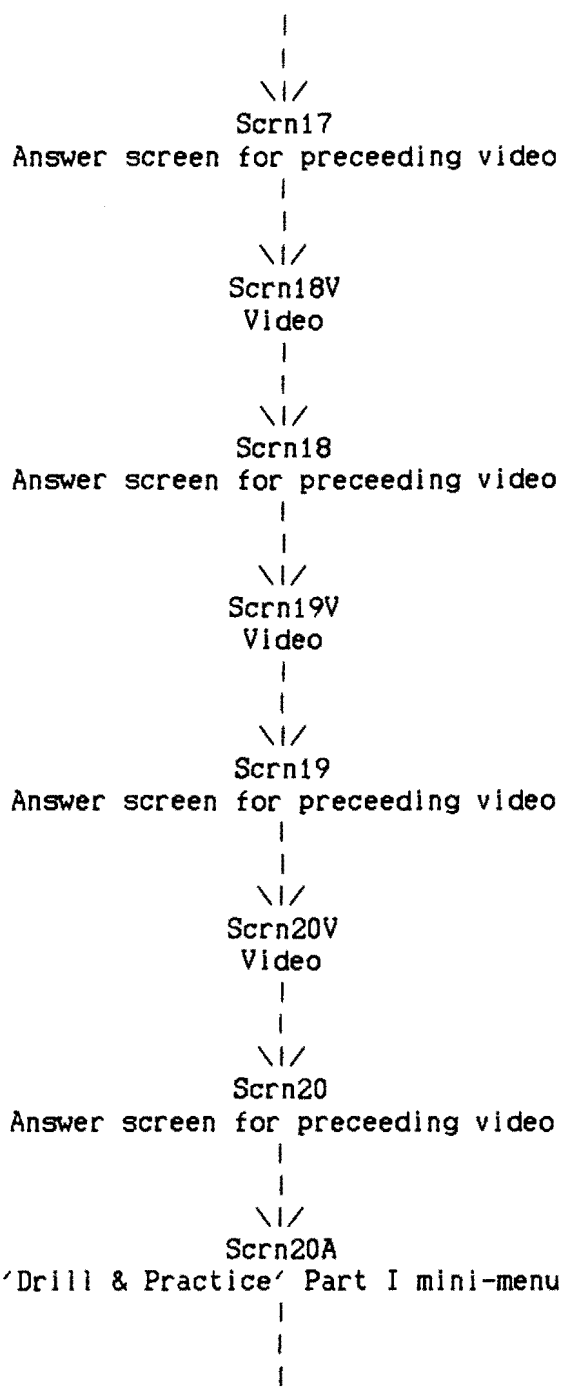


COMPUTER PROGRAM SCHEMA
Treatment 1
DRILL & PRACTICE









Pretit06

|

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Title06

|

\|/

Scrn06

Instructions for proceeding through part II of drill section

|

\|/

Scrn21V

Video

|

\|/

Scrn21

Answer screen for preceeding video

|

\|/

Scrn22V

Video

|

\|/

Scrn22

Answer screen for preceeding video

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Scrn23V

Video

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Scrn23

Answer screen for preceeding video

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Scrn24V

Video

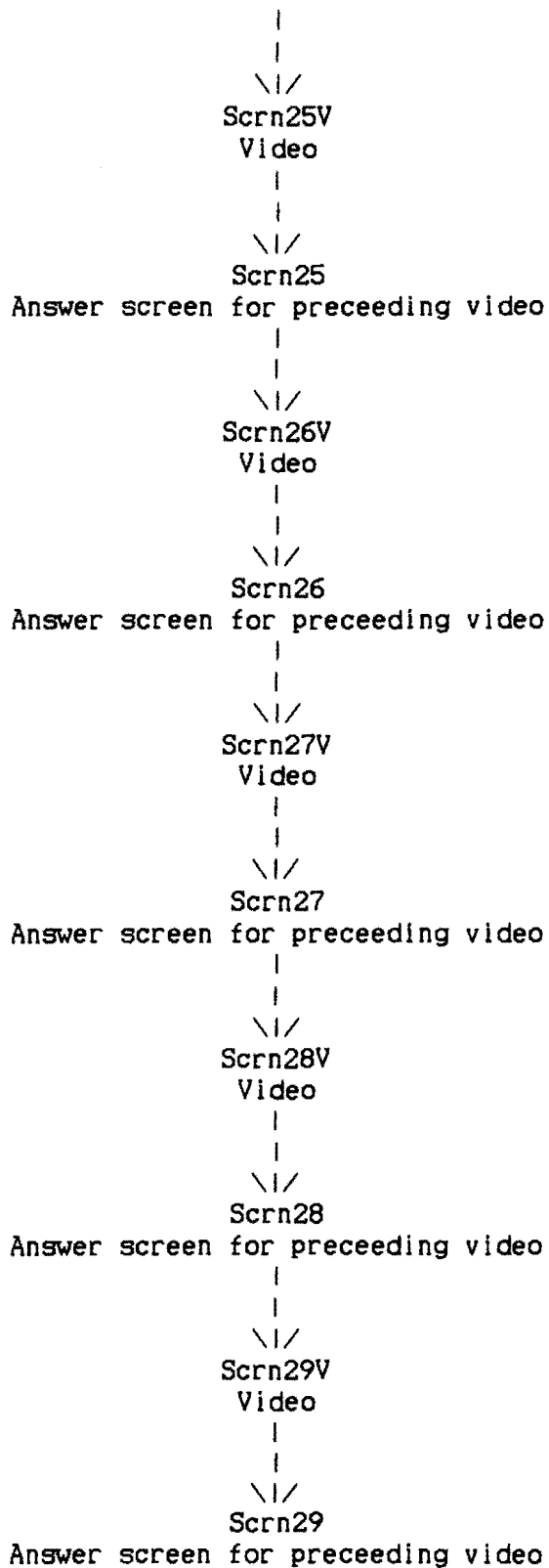
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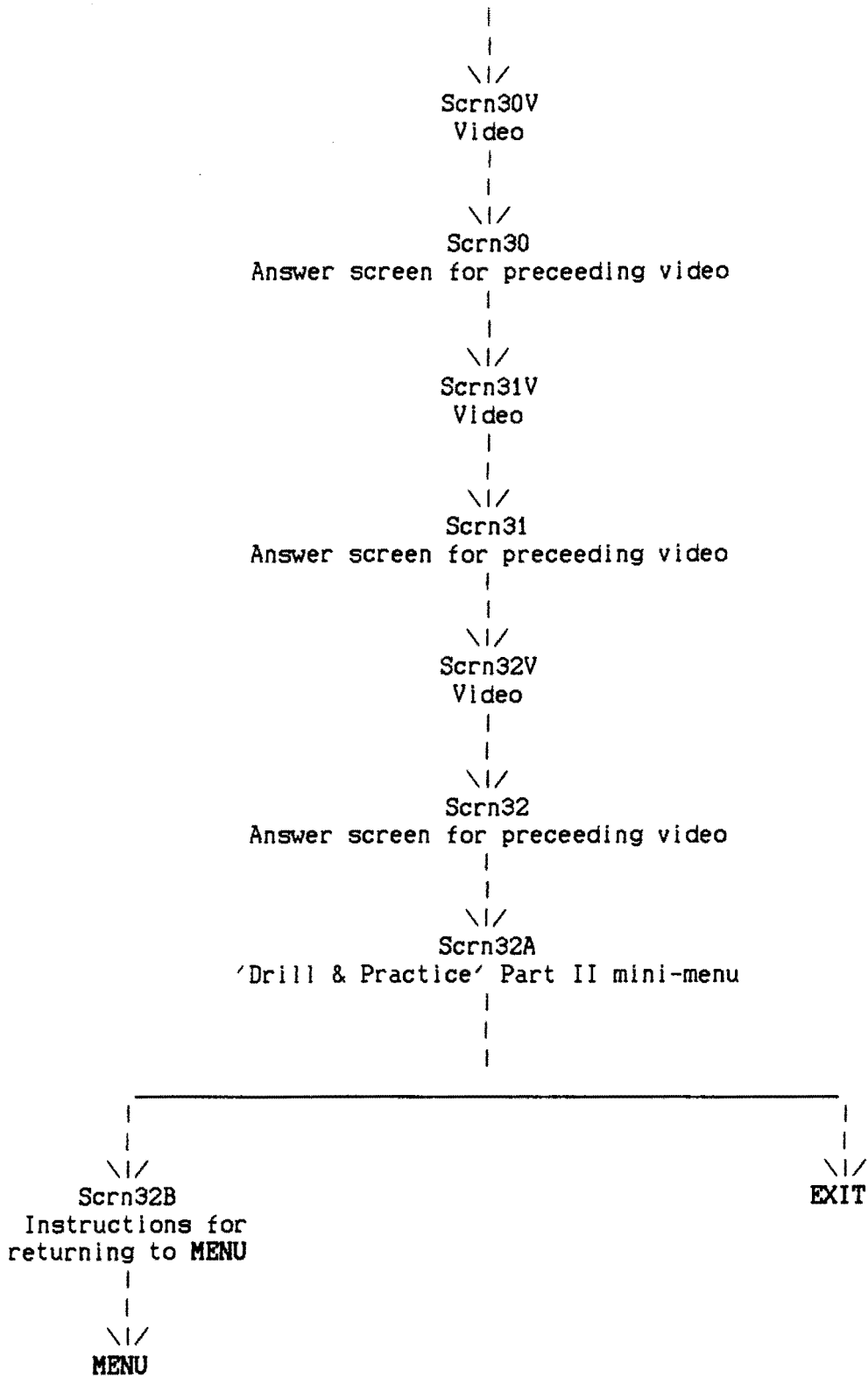
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Scrn24

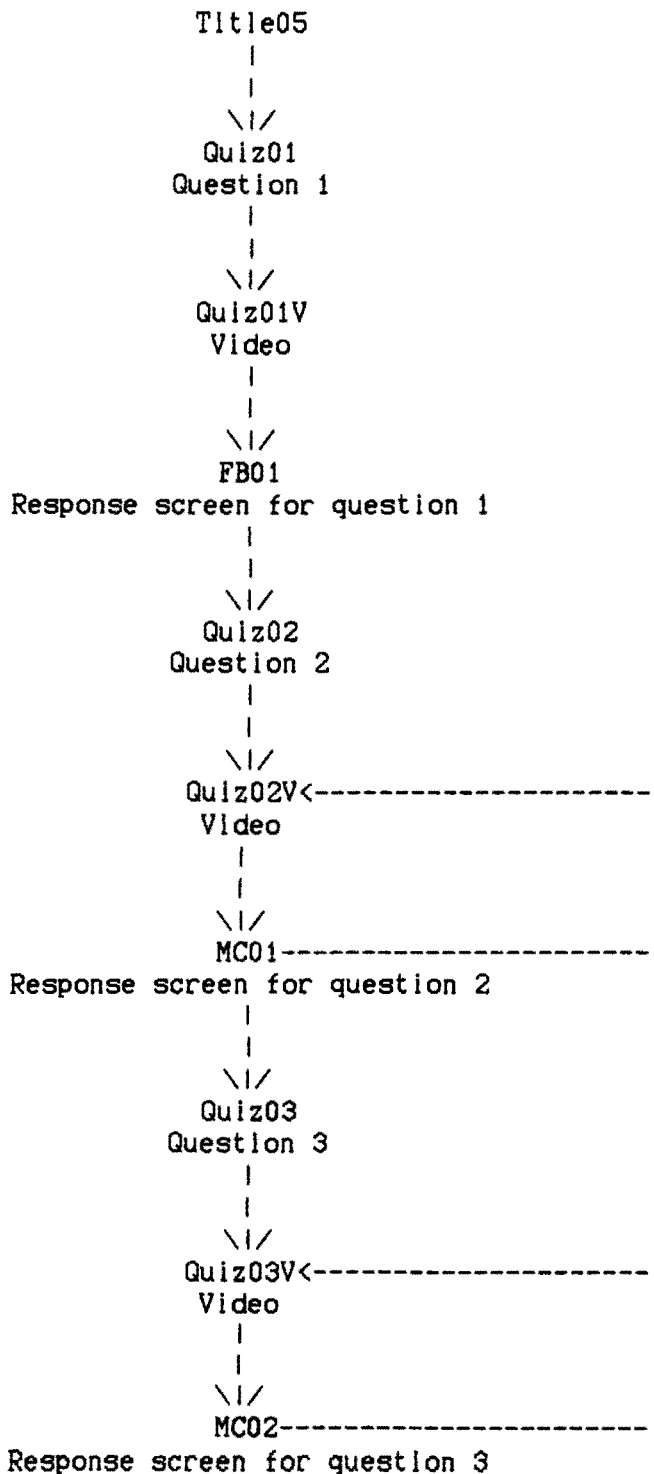
Answer screen for preceeding video

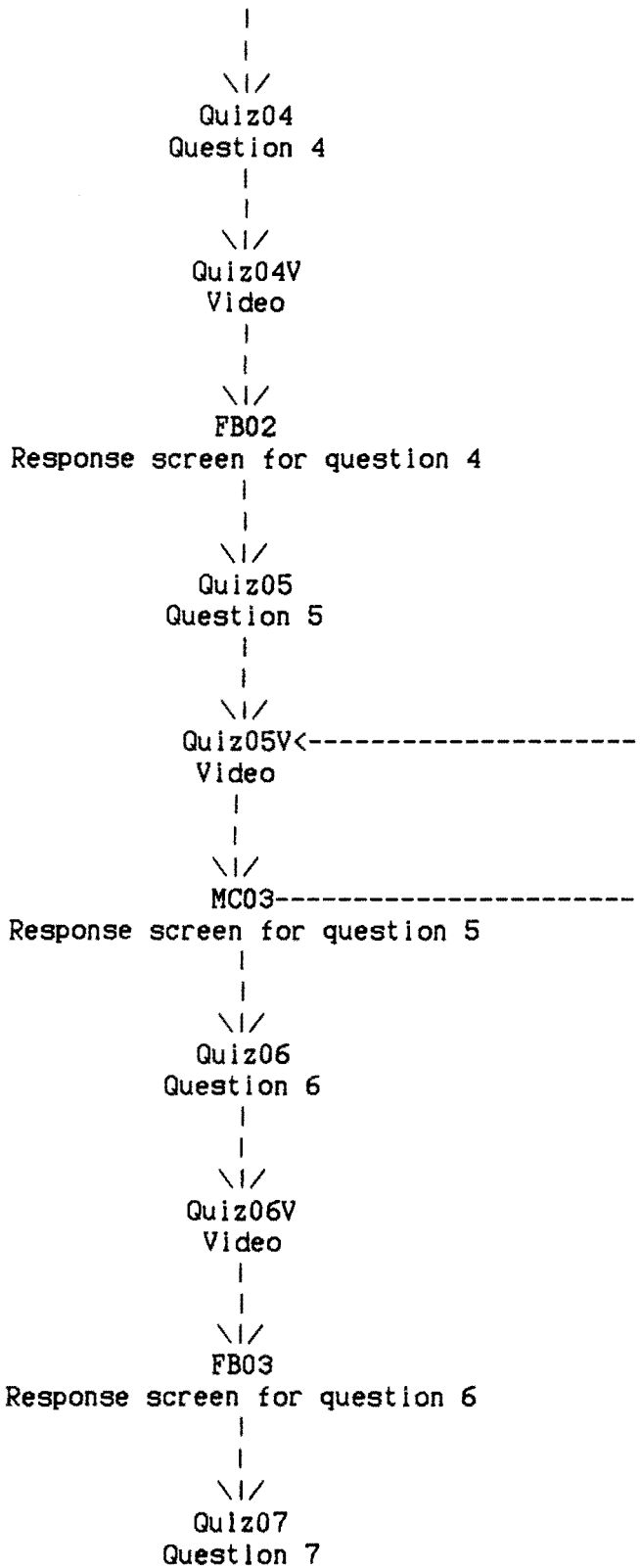
C-IV-4

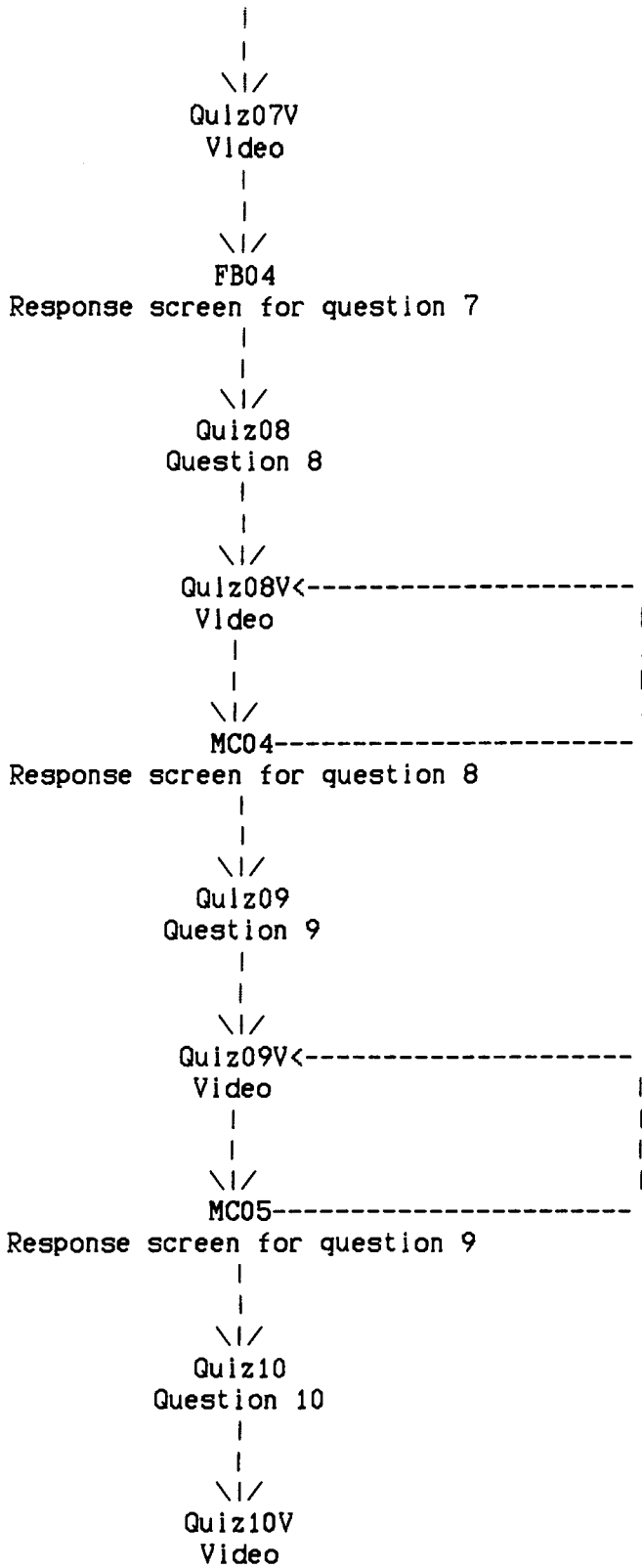


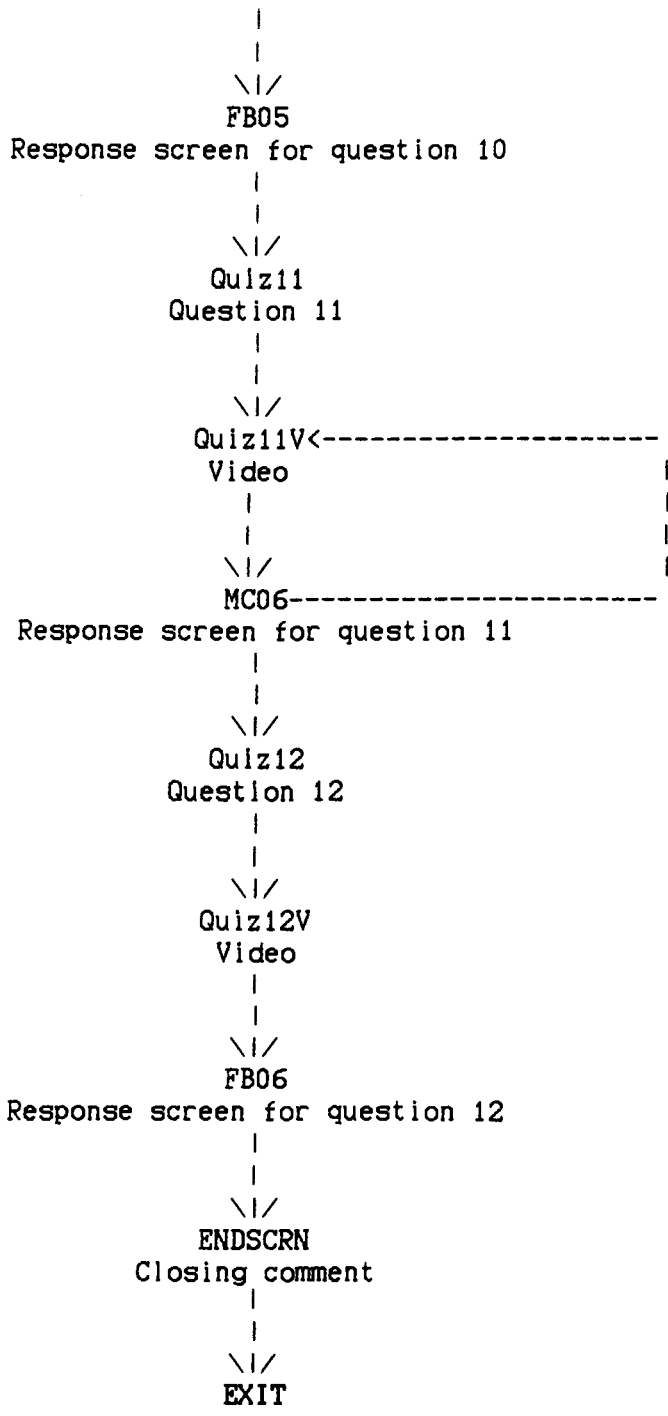


COMPUTER PROGRAM SCHEMA
Treatment 1
QUIZ

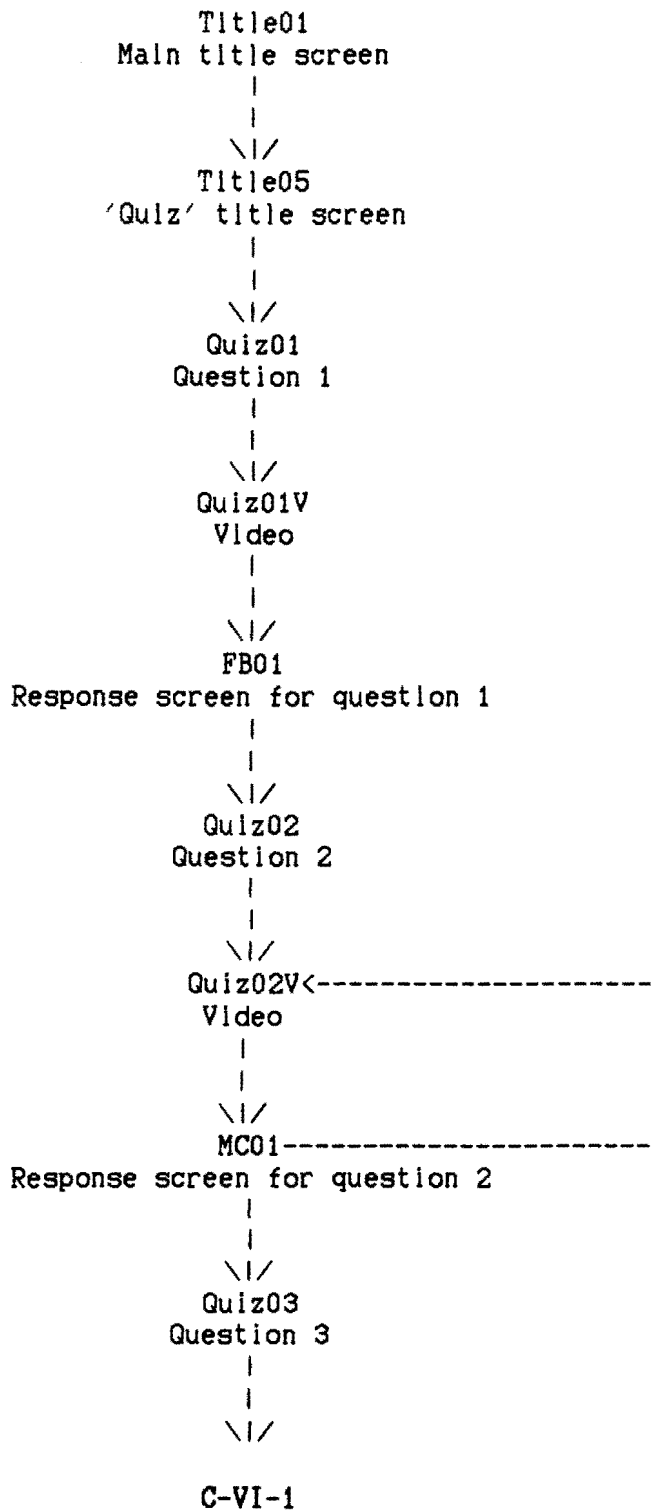


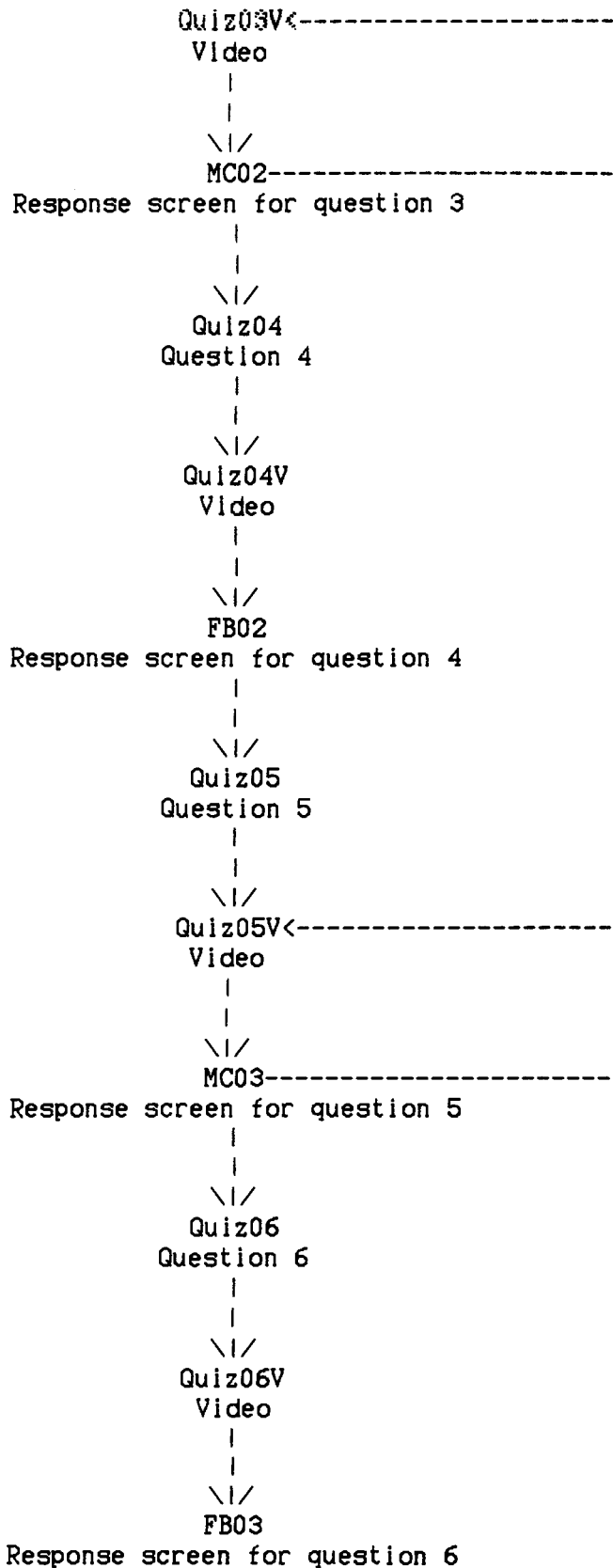


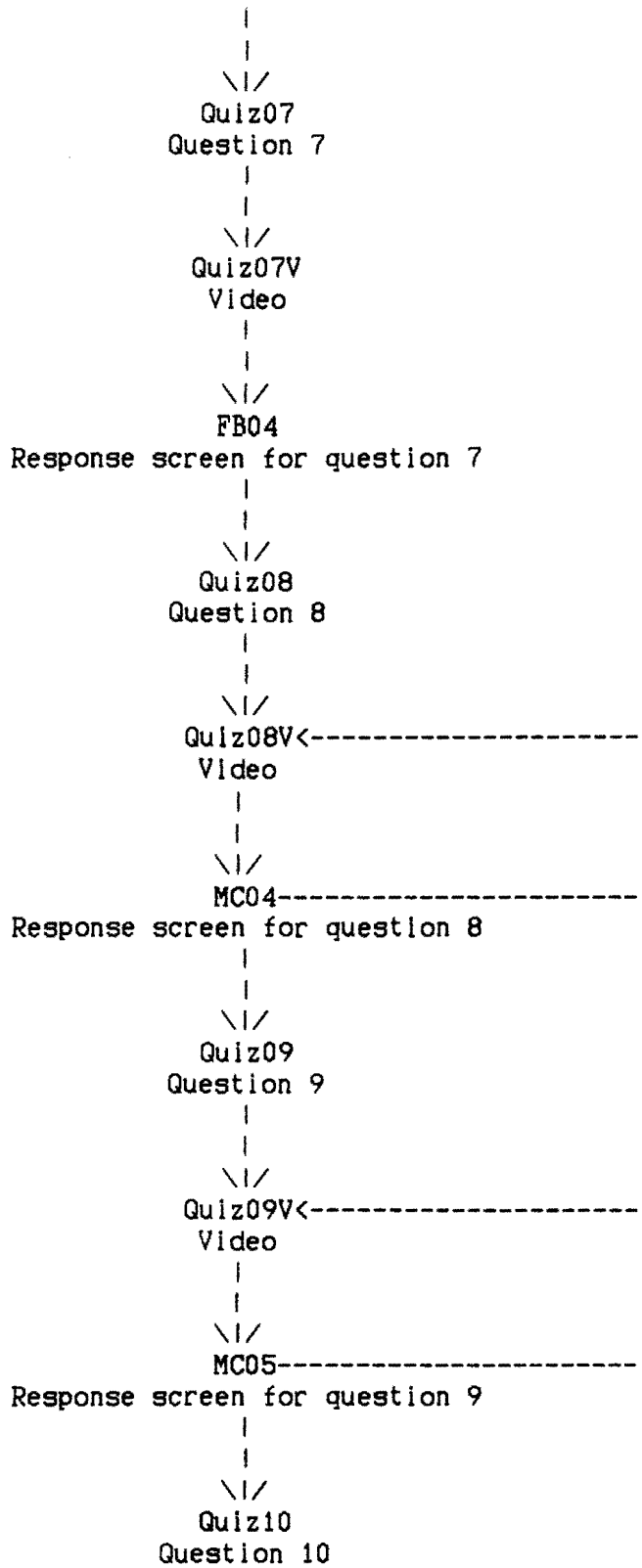


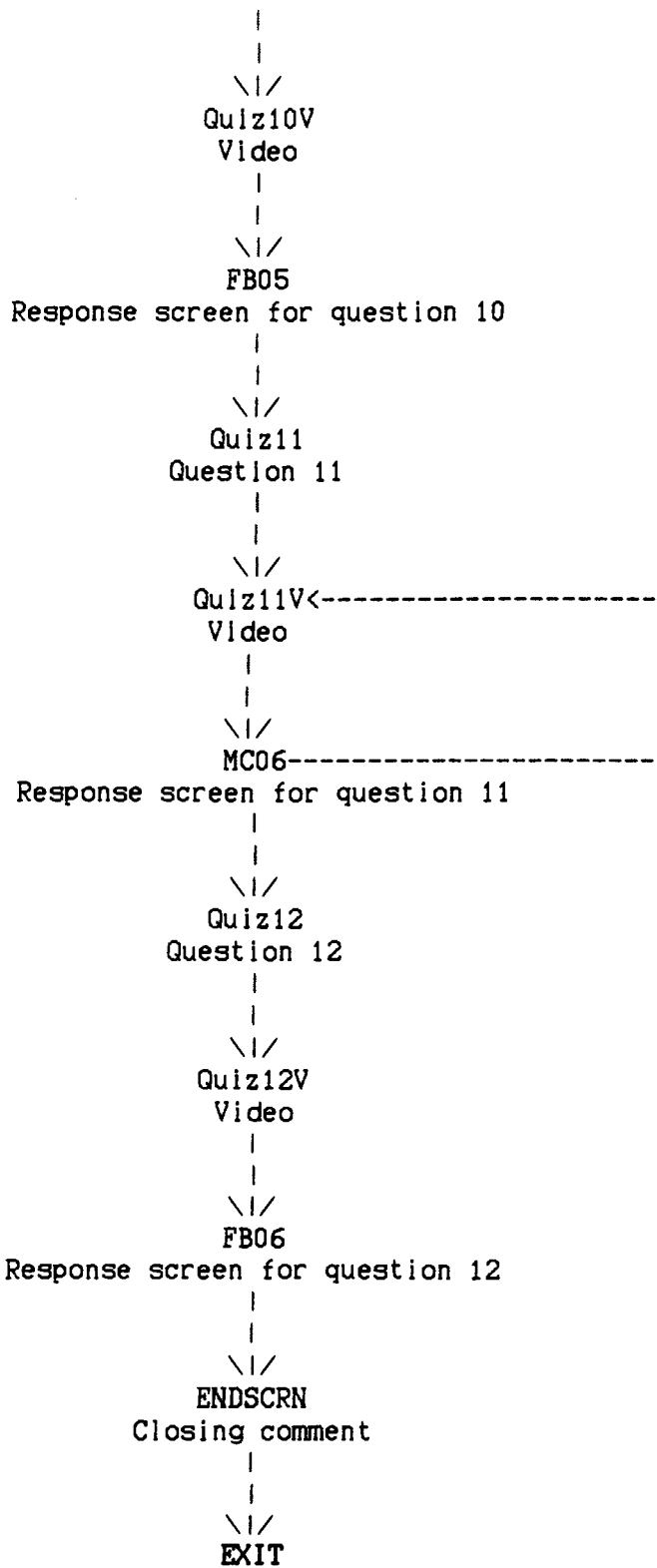


COMPUTER PROGRAM SCHEMA
Treatment 2









APPENDIX D

COMPUTER-BASED INTERACTIVE VIDEO

Signed English - Lesson: Foods

Welcome to the world of Computer-Based Interactive Video (CBIV). During interactive CAI, the computer works as a 'remote control' allowing you, the learner, to advance and review the lesson at your own pace. The videolink affects the hardware set-up in that (videotape) 'search time' or, instances where no image appears, occurs. Please do not interpret this as a mechanical breakdown.

To begin CAI, insert the Mc-Graw-Hill Delivery Disk in the left-hand drive and the diskette entitled "Introduction/Quiz" in the right-hand drive. Turn on the 1) monitor, 2) VTR, 3) videolink and 4) computer. A "Log On" screen will appear. Please fill in the information as follows:

LOG ON	
Name:	<u>Male or Female</u>
Identification:	<u>DOB Example: 010151</u>
Lesson:	<u>Foods</u>
Date:	<u>Present Date Example: 11/22/88</u>

The CAI is user-friendly. Screens will appear, periodically, with additional instructions, to guide you through the lesson.

APPENDIX E

SOFTWARE EVALUATION CHECKLIST

Faculty/Student (circle one)

(Please denote each response with a check mark.)

YES				NO
5	4	3	2	1

SCREEN LAYOUTS & INSTRUCTIONS

1. understandable					
2. user friendly					
3. good layout					
4. length of 'search time' such that loss of interest may occur					
5. program takes advantage of interactive capacities					

CONTENT

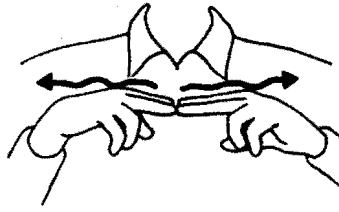
6. insufficient amount of material covered					
7. too much material presented					
8. content accurate					
9. pace appropriate					
10. feedback (drill) helpful					
11. quiz challenging					
12. program promotes mastery					
13. Compared to traditional teaching methods, does CAI facilitate material to be learned?					
14. Can this program act as a complete course unit or					
15. serve only to supplement the curriculum?					

COMMENTS/RECOMMENDATIONS

APPENDIX F

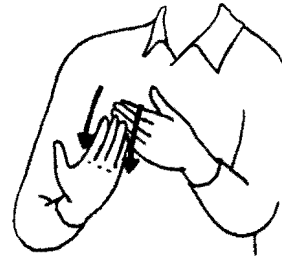
FOODS

BALOGNA



bacon

H shape both hands, palms down, tips touching. Draw away in wavy motion.



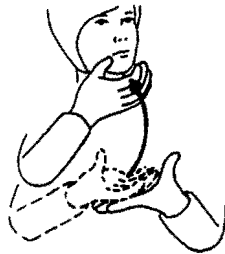
bread

LH open B palm in, tips right. Draw little finger side of right hand down back of left fingers several times.



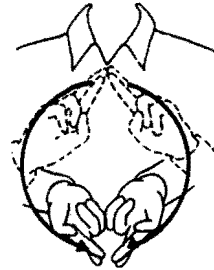
butter

LH open B palm up, tips out. Brush twice with tips of right H.



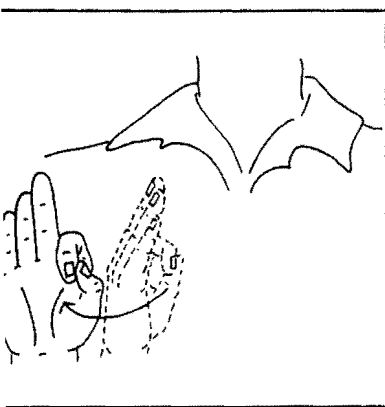
cereal

LH open B palm up, tips right. Place back of right C in left palm then lift to mouth.



doughnut

R shape both hands, palms out, fingers touching. Turn over, ending with R shapes touching, palms up.



FRANCE

Place the "F" in front of you, palm facing in; turn it so the palm faces forward, moving it slightly to the right and up.

Origin: Using the initial letter.

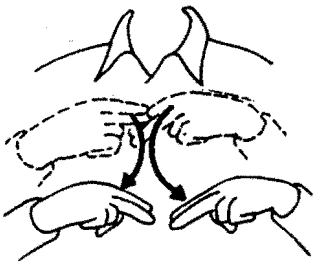
Usage: The Eiffel Tower is one of the attractions of *France*.

+



toast

Place tips of right V in left palm. Circle under and touch back of LH.



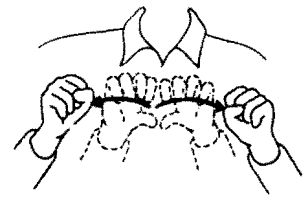
egg

H shape both hands, palms in. Hit left H with right H then draw hands apart.



fruit

Place the thumb and index of right F on right cheek. Twist, ending with palm in.



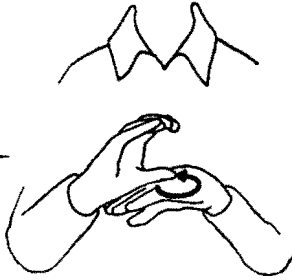
hot dog

Claw shape both hands, palms down, index fingers almost touching. Draw apart and close into S shapes.



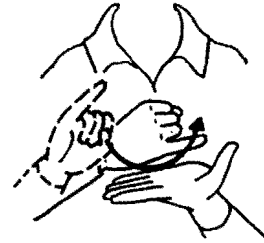
hot

Place tips of right claw on mouth. Twist wrist quickly so that palm faces down.



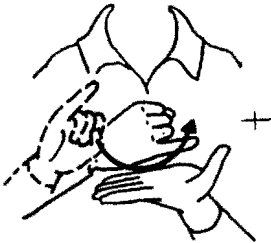
chocolate

Place thumb of right C on back of left hand and circle counterclockwise.



jelly

Dip right J shape into upturned palm of LH.

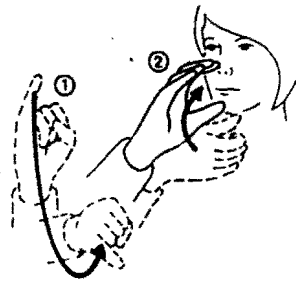


J am

Dip right J shape into upturned palm of LH.

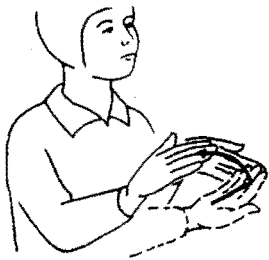


M



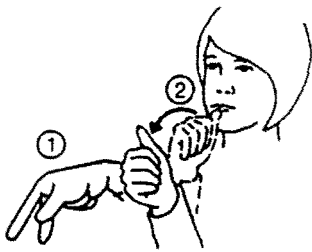
juice

Form letter J then raise cupped hand to mouth as if drinking.



pancake

LH open B palm up, tips out. Slide back of RH up left palm then flip RH over (as if flipping a pancake).

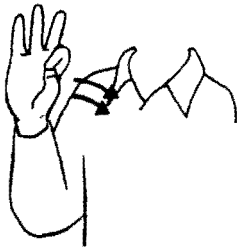


P + nut = peanut



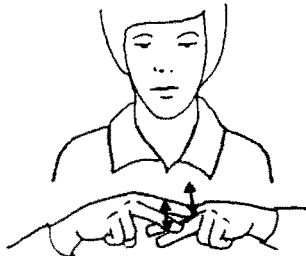
butter

LH open B palm up, tips out. Brush twice with tips of right H.



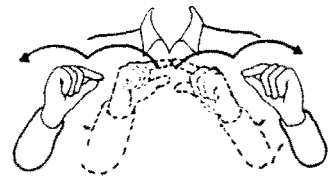
pepper

F shape RH. Mime shaking pepper shaker down to left.



salt

Tap right V on back of left V two or three times. (Sometimes the fingers of the right V move alternately against fingers of left V.)



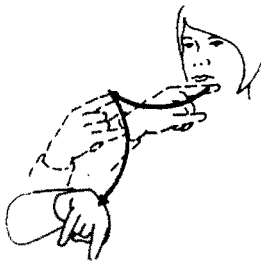
sausage

G shape both hands, palms and tips out, index fingers touching. Draw apart while opening and closing fingers, outlining links.



sugar

H shape RH palm in. Stroke tips down chin twice.



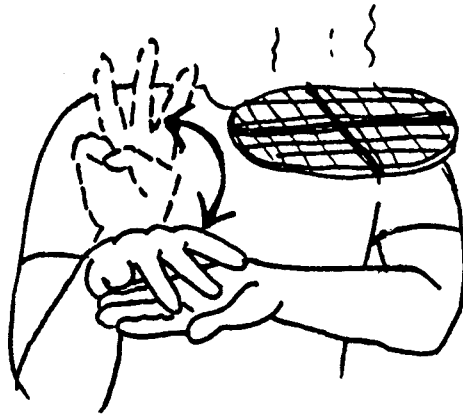
syrup

Extend right little and index fingers. Wipe chin with index and flip wrist out.



toast

Place tips of right V in left palm. Circle under and touch back of LH.



WAFFLE ★

Right W palm-down on left palm; lift again



water

Tap lips (or chin) twice with index finger of right W.

Sign illustrations taken from:

SIGNING SIGNED ENGLISH: A BASIC GUIDE
Bornstein & Saulnier

THE JOY OF SIGNING
Riekehof

SIGNING EXACT ENGLISH
Gustason et al

APPENDIX G

EXPRESSIVE SIGN <LANGUAGE> QUIZ

1. "Lunch" meat used to make a sandwich.

_____ correct _____ incorrect

2. A sweetner one might put in coffee.

_____ correct _____ incorrect

3. A beverage you get from the kitchen faucet.

_____ correct _____ incorrect

4. How bread might be prepared for breakfast.

_____ correct _____ incorrect

5. A cold, breakfast food milk is usually poured over.

_____ correct _____ incorrect

6. Meat that is usually served in a long, soft roll.

_____ correct _____ incorrect

7. Food seasoning and/or preservative.

_____ correct _____ incorrect

8. An ingredient, used with jelly, for making a quick sandwich.

_____ correct _____ incorrect

9. A thick, sweet, sticky liquid poured over pancakes.

_____ correct _____ incorrect

10. "BLT": _____, lettuce and tomato sandwich.

_____ correct _____ incorrect

11. A beverage that can be topped with marshmallows or whipped cream.

_____ correct _____ incorrect

12. A small, ring-shaped cake that is deep-fried.

_____ correct _____ incorrect

APPENDIX H

ANSWER KEY

Receptive Identification of Signs

bacon

butter

cereal

French toast

hot dog

jam

jelly

juice

salt

sugar

toast

water

APPROVAL SHEET

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

December 7, 1989
Date

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